

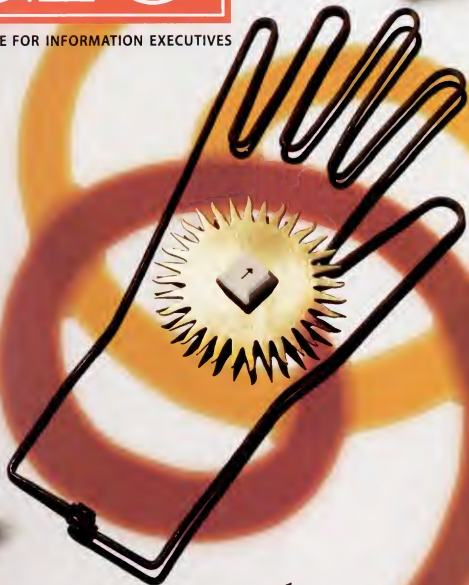


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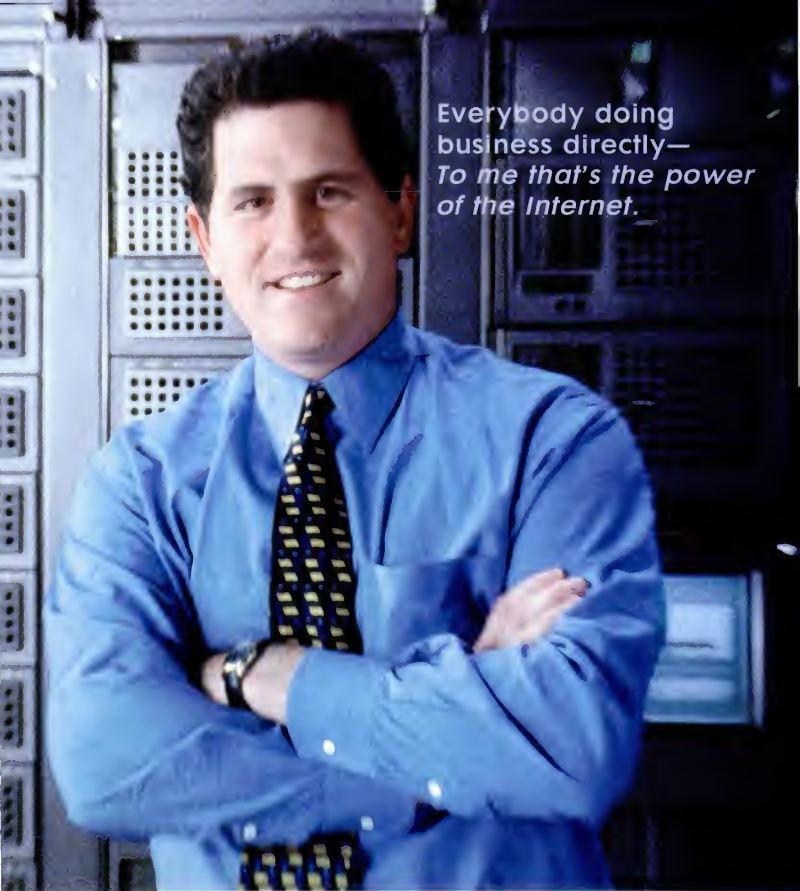


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FUTURE WORKERS AND CUSTOMERS

Today's schools are embedding technology into their curricula, and businesses need to prepare for these workers and customers these students will be.

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METRIC SYSTEMS Performance indicators must do more than just measure profits and losses. *By Polly Schneider*

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LETTER FROM THE EDITOR, READER FEEDBACK AND HOW TO REACH US

As a child in the early '60s, I was amazed that my grandparents were born in a different century from me. A century was such a long time, its turn a profound event. I don't think I believed that the next century, the 2000s, would ever really come (of course, middle age had that same improbable aspect). And now, here it is.

Many of you will have worked through New Year's, standing watch over Y2K. The weeks and months leading up to that event were split between making sure all was ready for the date changeover and desperately trying to figure out your organization's place in the e-universe. I suspect few of you had much time for reflection. That's unfortunate.

This issue of *CIO*, with the funny date on the cover, spans not only two years but two millennia (before you send any letters, I know that by at least one historic claim, the new millennium doesn't actually begin until 2001; but let's face it, going from the 1900s to the 2000s has much more symbolic significance). Confronted as we all are right now with the unsettling shifts taking place under our very feet, we wanted to offer you a break from the headlong rush to reflect on where we are going by looking back on where we have been. As dramatic as today's changes are, they all have roots somewhere in the past.

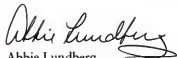
Perspective is a useful thing, but it's not enough. To get the most out of this issue, I suggest you read it through, then take that long-overdue holiday.

Spend some time thinking about your future, your company's future. Talk about it with your family, with others in your business. Come talk with us and other CIOs—we'll be hosting a discussion on our Web site at www.cio.com/forums. Because we are shaping history, you and I. We are in the act of turning the world into something that didn't exist before. We are the creators. And we are the destroyers.

If you choose to think of yourself as hapless flotsam being carried along on a tide of forces much greater than your own individual contribution, shame on you. You should resign your position today before you do any real harm.

The creators of this issue deserve recognition. Polly Schneider conceived and championed the concept over a year ago. Howard Baldwin helped shape the issue and drove the process. The team of intellectually inquisitive journalists who brought it to life include Cheryl Asselin, Mindy Blodgett, Kelli Botta, Elaine Cummings, Carol Hildebrand, Sari Kalin, Sandy Kendall, Meredith Levinson, Meg Mitchell, Katherine Noyes, Lynne Rigolini, Megan Santosus, Anne Stuart and Tom Wailgum; along with contributors Tom Davenport, Michael Earl, John Gantz, Leon Kappelman, Tracy Mayor, Bill Roberts and Lester Thurow. The truly smashing design is the work of Jessica Sepe and fellow designers Kaajal Asher, Terri Mitchell, Chandra Tallman and freelancers Leslie Feagley, Susan Gilday and Linda Koury.

From all of us at *CIO*, our very best wishes to you and your families for a healthy, happy and successful 2000.


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lundberg@cio.com

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Or to put it another way, from now on a lot of the stuff we eat, sleep and drink starts with an "e."



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WHO'S CALLING, PLEASE?

You're spot on with your point about PC user identities residing in the PC [Publisher's Note, *CIO*, Oct. 1, 1999]. While it would be nice for all the road warriors of the world, those of us largely tethered to a local complex of offices would also benefit from being able to log on and work from any location. This is especially true in health care, where caregivers roam among workstations while serving patients. Whether we move the identity to the network or move externally to some personally carried device, we would benefit from this flexibility in an environment where every dollar counts. Done properly, we could also improve security, another important and increasing concern to those of us dealing with medical privacy.

J. Scott Joslyn

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COLLABORATION? MAYBE.

While I agree with you on the strategic linkup between a CIO and CMO [chief marketing officer] to enhance price realization [Publisher's Note, *CIO*, Nov. 1, 1999], I do not agree completely that the CIO and CMO will work on such opportunities together. Collaboration, yes. But only in the short term.

Soon you will have individuals who have marketing and information skills in one and the same person.

Example? [Compaq's] Michael Capellas. To be successful, he must transition his own role to one that takes the advantage offered by marketing, based on his own background in information, in an integrated fashion until the fine boundary between the two functions disappears.

And let me also underline that for dynamic pricing to succeed the frontline of the organization (be it a sales outlet or a vending machine), there needs to be information and policy empowered to leverage the opportunity!

Ashish Atri

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ROUNDTABLE REGRETS

I was disturbed to see "The Bigger Picture" [*CIO*, Oct. 15, 1999] intermixing the terms strategy and long-range planning as if they were interchangeable. Certainly Gary Hamel did not encourage that.

Otherwise the report of the roundtable was interesting right up to Mr. Silivits' very insightful ending comment. However, the roundtable was disappointing because the discussion ended before the CIOs got to the question of their strategy and their long-range plans.

Most CIOs still don't get it. Their job must be more than just IT skill. Yes, they have to keep the enterprise apprised of opportunities and options as enabled by IT. But they should notice that the plant managers keep the enterprise apprised of opportunities and options as enabled by manufacturing technology. And so forth around the conference table. Granted the CIO covers a broader span of business considerations and technologies than do the others. But the big difference comes when the meeting is over. Each of the others has to go run their stores and get measured on their results. They think out their internal strategy and long-range plan for their part of the enterprise.

The difference is that the CIO doesn't strategize and plan how to run his or her own store. Most CIOs don't have a coherent organization chart, let alone a strategy or long-range plan to make sure the enterprise gets a good return for the several millions [invested] in the IT budget. If I am wrong, then let's see a CIO describe his own organization's mission, vision, structure, strategy, initiatives, goals, budgets, processes and scorecards.

Apparently Compaq's stockholders and the investment community in general share this view ["Can CIOs Make Good CEOs," In Box, *CIO*, Oct. 15, 1999]. Their reaction likely had very little to do with the specifics of Michael Capellas' competencies but were largely conditioned by the lack of management behavior exhibited by CIOs in general.

Jack Ring

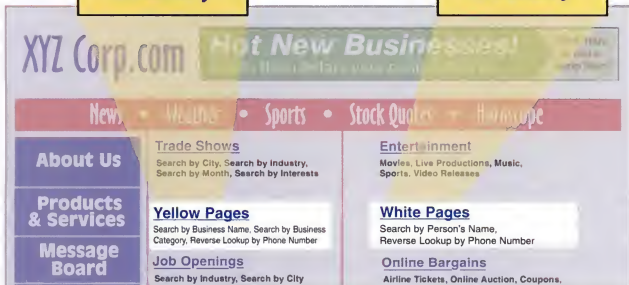
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In My Opinion

I CONTINUE TO BE AMAZED THAT some top executives of midsize and large companies still question what benefits are being derived from their information technology investments.

Since the theme of this year-end issue of *CIO* is "Decoding the Past. Inventing the Future," I thought it would be appropriate to provide some facts you can use to help demonstrate the power of IT and its role in the economy. Consider the following trends as you contemplate the value of your company's IT efforts.

Information technology industries have been growing at more than double the rate of the overall economy. They now represent 8.2 percent of GDP, up from 4.9 percent in 1985.

IT industries by themselves have driven more than one-quarter of total real economic growth on average (not including any indirect effects) over each of the last five years.

The Internet Economy, which consists of products and services ranging from electronic commerce to Internet infrastructure technology, generated an estimated \$301.4 billion in U.S. revenues in 1998.

The average revenue per Internet Economy worker is about \$250,000, or about 65 percent higher than their Industrial Age counterparts.

U.S. businesses will spend over \$200 billion on Internet technology deployment by 2002, comprising 20 percent of technology spending, according to International Data Corp.

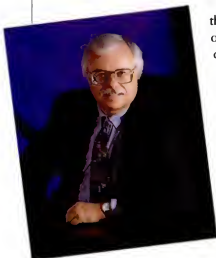
Without information technology, overall inflation would have been 3.1 percent in 1997, more than a full percentage point higher than the 2 percent it was.

Business-to-business e-commerce will rise to \$1.3 trillion by 2003, according to Forrester Research Inc.

Those are just a few factoids you can use to point out to your friends, family and management that IT is where it's at. Have a happy and healthy holiday season. As always, I appreciate your thoughts and comments.

Joseph L. Levy
President and CEO,
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**The Internet
Economy generated
an estimated
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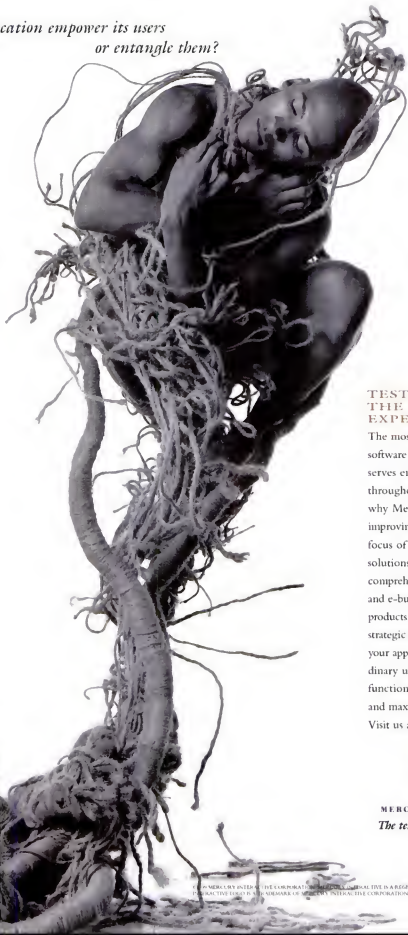
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Trendlines

NEWS, INSIGHT, HUMOR, REVIEWS

Edited by Katherine Noyes

Snapshot from Space

APOLLO 11 What's bigger than a breadbox, weighs more than 70 pounds and packs less computing power than a typical video game console? The computer used onboard the Apollo 11 spacecraft when it made its historic voyage to the moon and back just over 30 years ago. Huge mainframes on the ground controlled the mission, according to Carnegie Mellon University's James Tomayko, a former NASA consultant who now directs the software engineering master's program at CMU in Pittsburgh. But the onboard computers—one in the command module, which orbited the moon, and the other in the lunar explorer itself—were used for some aspects of navigation and timing, and they could, if needed, guide the craft back home on its own. Designers thought of the onboard computer systems as the fourth crew member.

To minimize size and weight and improve performance, MIT engineers designing the computers decided to use integrated circuits rather than discrete transistors. Integrated circuits were then a three-year-old technology with no track record for reliability. "They really took a chance on that," Tomayko says. "Everything else was very conservative. They wanted to use older technology to make sure it would work." The circuits were simple, made up of three transistors and four resistors, and each computer used about 5,000 of them. By the time the spacecraft launched in 1969, the onboard computers' technology was already out of date.

There was one notable software glitch during the Apollo 11 landing, Tomayko says. The operating system was designed to schedule jobs in a cycle, devoting a few milliseconds to each; a request to increment the count in the memory register had priority over other jobs. If a job did not get done in 20 milliseconds, the system would reboot itself. When the lunar explorer module was descending to the moon, the so-called rendezvous radar hogged so many computing resources that the system restarted itself several times, setting off warnings in the craft and on the ground. Experts at Mission Control realized what the problem was and decided it was OK to land. The rest is history.

For more in-depth information about the development of the computers aboard Apollo 11 and other spacecraft, check out Tomayko's report for NASA, "Computers in Spaceflight: The NASA Experience," on NASA's Web site at www.hq.nasa.gov/office/pao/History/computers/Compspace.html.

—Sari Kalin



Looking Backward

Forecasting even short-term technology and business trends can be risky business. Remember Ethernet inventor and Internet pundit Bob Metcalfe's famously unfulfilled prophecy that the Internet would collapse under its own weight in 1996? (When the Internet didn't crash, Metcalfe literally ate his own words—a copy of his column—

onstage at a conference.) Yet every December, gurus, consultants, researchers, authors and futurists all try to predict what will fly and what will die in the next 12 months. (See "In the Year 2525," Page 44, for a light-hearted example.)

Many 1998 prognostications came true in 1999. But then, a lot of those fell into the

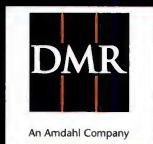
no-brainer category. For example, nobody went too far out on a limb by predicting that, in 1999, Internet stocks would soar and crash, soar again and crash again. Other predictions contradicted each other: Some pundits projected additional portal proliferation this year, while others insisted the trend had run its course. A few key developments pretty much



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escaped everyone's crystal ball: A year ago, nobody really predicted the rapid rise of vertical, or special-interest, portal sites; nobody had yet invented the term *click-and-mortar* to describe companies combining their online and offline businesses.

As the year draws to a close, some 1998 predictions don't appear to be in the cards for 1999:

Digital Duds GartnerGroup Inc. of Stamford, Conn., included wearable computers in its list of 10 technologies to watch in 1999. How many belt-mounted computers or keyboard bracelets did you see this year?

Electronic Books GartnerGroup also advised watching for these paperback-size devices, which let users download books and other publications from the Web. E-books did begin popping up this fall, but they remain a novelty.

My Firewall The *Web Informant*, an e-mail newsletter, predicted that anybody with a

permanent Internet connection—even at home—would start thinking about corporate-level security. But do-it-yourself firewall kits haven't exactly become household items.



Making Money New York-based PricewaterhouseCoopers said companies would start to see significant returns on their e-commerce investments by the end of 1999. But for most companies, serious e-commerce profits are still somewhere over the millennial rainbow. —Anne Stuart

When Women Rule the World

INTERVIEW Anita Borg, a researcher with Xerox Corp.'s Palo Alto Research Center in Palo Alto, Calif., is a leading advocate for the advancement of women in technology careers. She founded the nonprofit group Institute for Women in Technology (www.iwt.org) and leads technology idea workshops for women nationwide. Recently she spoke with *CIO* about the role of women in corporate America, 20 to 30 years down the road.

Q: If, in 20 years, there are as many women as men at the executive level, how will that affect management and corporate culture?

A: Women will change the corporation more than we expect. I think that even today, an awful lot of women still need to be "one of the boys" in order to succeed. And the range of behavior that's acceptable for women in those positions is still considerably more narrow than it is for men. When half of the Fortune 500 CEOs are female, the top-level meet-

ings across corporations will have a different feel to them. Leaders of the future will have to be visionary and be able to bring people in—real communicators. These are things that women bring to leadership and executive positions, and it's going to be incredibly valuable and incredibly in demand.

Q: Do you think women will have a big impact on the types of products and services that companies are going to deliver in the future?

A: Women's markets are dealt with very stereotypically right now. Having lots of women in senior leadership positions may lead to a more reality-based perception of women's markets. The way we view women as consumers of high-tech stuff will be open to change if women are there throughout the corporate hierarchy.

The women I have met who are starting companies are often more committed to the end vision of the company, of actually making that product or service happen and getting it out. I am very distressed by the tendency in Silicon Valley for people to create companies with the primary goal of being bought, not of providing a service or a product. The idea is to get it far enough that somebody will buy you, and who the heck cares what they do with it down the road. With women, the reason they're doing it is because there's a need. They can create a company that both pays salaries and makes some money for folks but meets a need. And that, for me, matches another perspective, which is that women frequently think of things they buy in terms of tools rather than toys—whether it's a computer or cosmetics.

—Polly Schneider



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CENSUS 2000 Right now, approximately 275 million people live in the United States and its territories. Imagine you have to count them all on April 1. Tough job. And not only do you have to count them, you have to assign each individual an address, or at the very least a hometown. Think of all the leases that are up March 30, how many April 1, how many babies are born that houses are not quite finished.

The crucial development for this decade's census is the optical scanner. No more No. 2 pencils! No more filling in little circles! The scanners can read handwritten letters in pencil or ink and translate them to computer code—just one component in a system designed by Lockheed Martin Mission Systems. The code is then transmitted to one of four data capture centers around the country for processing. The center in Indiana is a permanent Census Bureau installation; the other three are just for Census 2000 and contracted to TRW.

Despite the technological advances, Census officials expect to get results only comparable in accuracy to the 1990 census, which Kenneth Prewitt, director of the bureau, admits "did not please the Census Bureau or the Bush administration or Congress or governors, mayors, and other state and local officials, or a large number of private and public sector data users, or the American public."

The Census Bureau is running faster to stay in place, he says. Why? Technological gains have helped keep pace with the sheer volume of work resulting from a larger population, but so far the Bureau hasn't found a way to over-

Technology is not free of blame, either. Census folks acknowledge that the heaps of database-generated junk mail that crowd most people's mailboxes make them more likely to overlook or toss the census form when it arrives. And people who have always been wary of government have become downright hostile in an era in which extensive computer networks seem to threaten privacy.

INVENTIONS The 20th century produced countless inventions that have changed the way people live their lives. Which have had the biggest impact? A recent survey by Harris Corp., a Melbourne, Fla.-based communications equipment company, with support from the University of Florida, asked 1,000 American consumers what technology they thought was the top innovation of the past century. The top five named were

- 1) computer (named by 40 percent)
- 2) television (12 percent)
- 3) refrigerator (12 percent)
- 4) medical advances (6 percent)
- 5) the Internet (5 percent)

What about Americans' expectations for the future? Fifty-four percent of those surveyed felt that a cure for cancer or AIDS would be the top accomplishment of the 21st century; 19 percent said that solving world hunger through advanced agriculture would be the top achievement.

For more information, visit www.harris.com. ■



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So the overwhelmed and the paranoid won't get counted. How much can that matter? About \$200 billion worth, actually. The government uses the census to determine how to apportion funds as well as how to define congressional districts and whatnot. And the people most affected by the undercount are those farthest from the warm hearth of technology. Minorities, the poor

and the transient are overlooked proportionally more than their white, middle-class compatriots are. This inaccuracy leads to civic inequities and potential business losses. For example, Prewitt says, "When Wal-Mart decides to put an outlet in a particular community, [its people] look at census data. They look at the age composition and the growth pattern of that town. They look at the ethnic composition of that town. I couldn't begin to estimate the dollar amount of the business investments that depend upon census data." —Sandy Kendall

R&D in an IPO World

INNOVATION Unix as we know it today evolved over the better part of two decades under the protective gaze of Bell Laboratories Inc. TCP/IP wended its way through various iterations for nine years before it became an ARPANET standard and then took another decade to make its way into widespread commercial use. Ray Ozzie cooked Notes for eight years before serving it up to the general public. (See their profiles in "Inventing the Enterprise," Page 126.)

On the eve of the millennium, when IPO fever is rampant and the posting of a single quarter's results can make or break a company, can any technology or product still take that kind of time to come to market? Probably not, say several inventors of enterprise technology who know a thing or two about innovation.

But that doesn't mean the climate for creativity is necessarily bad. In fact, David A. Patterson, one of the inventors of reduced instruction set computing (RISC), says that technological innovation has become more democratic over the years. "Com-

panies are more receptive to radical ideas." Back in the early 1980s, when Patterson was working on RISC, "innovation was for researchers at a university only," he says.

Now, any Silicon Valley startup that manages to secure sufficient funding from venture capitalists can join in the game. In fact, venture capital has proved to be quite fertile soil for fostering innovation, says Java creator James Gosling. "One of the hallmarks of people doing truly innovative things is their [tolerance] of failure," Gosling points out. "Most corporations don't like failure, but venture capitalists are expecting it. Ninety-five percent of their investments fail."



"I'm looking forward to getting Y2K behind us so we can get back to the normal chaos."

—Bill Fifield, CIO for Navy Exchange Service Command (Nexcom) in Virginia Beach, Va.

Gordon Bell, father of the VAX minicomputer, is bullish on the range and type of innovation coming from startups in Silicon Valley and technology hot spots around Seattle, Boston, Atlanta and New York. "The rate of innovation today is unprecedented," he enthuses. "We're getting on the order of 10 new startups a day in Silicon Valley."

Most such startups are now set up from the outset to function not as independent companies

but as individual projects

that expect to be bought up somewhere down the road. "It's a way to do projects that large companies can't do anymore," Bell says. In general, startups are simply more nimble than established technology powerhouses.

Expecting to be acquired is one thing, these inventors say, but expecting to make a killing off the stock market in your first year of business is something else entirely. Java's Gosling is just one of several pioneers who deplores the current craze to go public. "One of the things that is verging on a tragedy is that you're no longer trying to build a viable business; you're trying to fly an IPO," he says. —Tracy Mayor



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A Room with Many, Many Views

OFFICES OF THE FUTURE Move over, office furniture. If the folks at British Telecom's research and development center in the United Kingdom have anything to say about it, the pale gray desk and chair sets that populate most offices are on their way out.

"The desk you have now is ideal for writing a paper, not for using technology," says John Collins, a senior research engineer at BT.

Enter Smartspace, a new virtual workspace that consists of a desk and chair with a wraparound projection screen that allows for multiple data streams and surround sound. Users can view data in a wide or split screen and can control an onscreen keyboard connected to a liquid crystal display either by voice recognition or by a finger or pen on the display service. Rotating the chair controls a remote camera, so a user can view a roomful of people via videoconferencing. Smartspace is semi-immersive, meaning the user can plug in to the virtual environment and still tune in to what's going on around him.

Smartspace is manufactured by Incorporated Technologies Ltd., which has licensed BT's patent. For now the price tag is pretty steep—the fully loaded version sells for about £42,000 (about US\$70,000)—but BT expects the price to come down as production increases.

One company in England has already licensed Smartspace to use as a point-of-sale kiosk, and BT hopes to market it to airport traffic controllers or traders—anyone who needs to keep an eye on several screens at once. Someday, researchers hope, Smartspace will be common in your garden-variety office building, and BT will be able to offer customized versions for specific functions. ■



Slicker Cities?

URBAN PREDICTIONS It's one thing to speculate about the future of information technology or of the corporation. But even more central, perhaps, to the tenor of our lives in the coming decades are changes that will occur closer to home—right where we live, in this country's cities.

A recent article in *Preservation* magazine collected various predictions by urban experts about what America's cities might look like in the year 2050. By that year, *Preservation* notes, there will have been dramatic changes in the U.S. population. For starters, there will be almost twice as many of us—400 million. Twenty percent of us will

be over 65, while a quarter of us will be Hispanic, with white school-age kids a minority for the first time among their peers. Winters will be wetter and summers will be hotter. Three-fourths of the world will live in



cities, since unclaimed land will be a rarity by then.

What follows are selected visions of the future American city, culled by *Preservation*:

■ **The Cyber City** As a result of the Internet, the new dominant urban life form will be the borderless metropolis, in which a city is defined by its online interactions. Lack of adequate Net connections will create a new metropolitan underclass, according to the Taub Urban Research Center at New York University.

■ **The Galactic City** In this view, Pennsylvania State University geographer Peirce Lewis describes a relentless urban expansion that splinters natural habitats

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and devours once-freestanding towns. To wit: "Lancaster County, Pa., 125 miles from Manhattan, is the newest fringe of New York commuter country; development around Phoenix now gobbles Sonoran desert at the rate of one acre every hour."

■ **The Green City** Portland, Ore., established an urban-growth boundary in the 1970s, and many experts credit that move with preserving the health of the city's urban ecology. As Ethan Seltzer, director of the Institute of Metropolitan Studies at Portland State University, told *Preservation*, "It has forced people not to just use and abandon urban places but to use and reuse them."

■ **The Out-of-Control City** Population growth in supercities such as Lagos, Nigeria; Dhaka, Bangladesh; and Sao Paulo, Brazil, will continue to skyrocket, leaving 1.4 billion city dwellers without basic services by 2010. In our hemisphere, visits to New York, Mexico City and Los Angeles might require "a special travel kit of antibiotics, insecticide and barter goods like peanut butter or batteries."

■ **The Tourist City** As tourism evolves into a dominant economic force, many cities will develop a tourist bubble catering to out-of-town visitors and protecting them from any unpleasantness elsewhere in the city. A current example:

Boston's Freedom Trail and Faneuil Hall Marketplace.

■ **The Global Warming City** In a June 1999 statement, the Red Cross predicted that climate change, environmental damage and population pressures will combine to make weather-related superdisasters the key feature of the next century. Global warming will lead to flooding that will reclaim large portions of coastal cities such as New York.

The overall picture? Kind of makes Y2K look like nursery school. Fortunately, predictions don't always come true (see "Looking Backward," Page 26). Let's hope many of these don't. ■

"We will have a robot that dresses us. The robot knows when you are ready to get dressed because it watches you. You can tell it what you want to wear. Then it will pick up the dress and tell you to put up your arms. At the end of the day, the robot takes off your clothes and puts on your pajamas. The robot even puts your clothes in the laundry."

—Nicole M., 11
For more on children's views of the future, see "Children of the Revolution," Page 158.



Top 10 Signs That You've Had Too Much of the '90s

END OF A DECADE

10. You try to enter your password on the microwave.
9. You haven't played solitaire with a real deck of cards in years.
8. You have a list of 15 phone numbers to reach your family of three.
7. Your daughter sells Girl Scout cookies via her Web site.
6. You buy a computer and a week later it's selling for half the price you paid.
5. Cleaning up the dining area means getting the fast food bags out of the back seat of your car.
4. Your reason for not staying in touch with family is that they do not have e-mail addresses.
3. You consider second-day air delivery painfully slow.
2. You refer to your dining room table as the flat filing cabinet.
1. You hear your jokes via e-mail instead of in person.

And the top sign that you've had too much of the '90s...

1. You hear your jokes via e-mail instead of in person.



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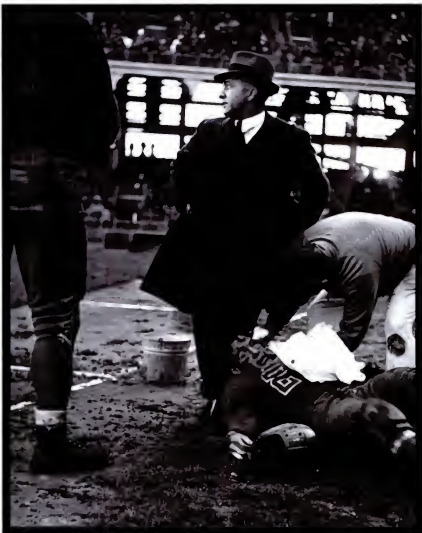
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In the Year 2525

What does the future hold for IT? This futurist goes out on a limb to say, "It depends."

BY TOM DAVENPORT

WHEN I WAS 5 YEARS OLD, I remember speculating on what life would be like in 2000, when I'd be middle-aged and my life half over. I'd gaze at the moon and imagine I'd be living on it by then. I also anticipated I'd have a wife and a couple of kids, so I wasn't all wrong.

Eventually, we members of the Future Futurists of America got together and agreed to hedge our bets after we saw what happened to Jeane Dixon's predictions for the new year back in 1972. It wasn't pretty when even *The National Enquirer* started tracking what percentage of Jeane's bold statements actually came to pass.

Luckily for me, no one has ever held me accountable for my less-than-accurate predictions. (Or perhaps because I change jobs and e-mail addresses fairly often, their messages just haven't caught up with me yet.) I hesitate to admit that I, like all sane futurists, fudged things a bit and embedded predictions into wise remarks about the drivers of future change.

I'd prefer to make predictions now about things that the average American really cares about, such as when Dick Clark will stop looking like a 39-year-old, but my editor wants me to prophesize on the future of information and technology in business. I will grudgingly comply, although it will probably ruin my chances that the *Enquirer* will pick up this story.

The future as I see it depends on how certain questions about informa-

tion, IT and business are answered (that's my hedge). These questions are so critical that, if they are answered by citizens of the Future State in ways other than what I predict, then all bets are off. I will also leave unspecified the time frame in which the answers to these questions will come to pass. If you're reading this 20 years from now and the things I predict haven't happened yet, just be patient and wait awhile longer. You've got to admit, it's a clever strategy.

Here are my questions:

Will there always be a CIO role?

I don't think so. At the turn of the last century, we had vice presidents of electrification to manage how electricity was introduced into an organization. We needed CIOs for the early days of fitting computers into a company, but it won't last. We will continue to need people who manage the organization's informational and intellectual assets, but they'll be called chief knowledge officers or senior vice presidents of organizational learning and intelligence. Most audiences find the word *knowledge* to be more interesting and glamorous than *information*, so perhaps in a few years we will all be

managing *wisdom*. (Just in case, I'm thinking of copyrighting the term *wisdom management*.)

Will we buy less technology in the future?

Absolutely. Let's face it—very little that we do requires the power of current technologies. It also appears likely that microprocessors will eventually cease their relentless march toward doing all the world's calculations in 14 nanoseconds. When the circuitry can't get any smaller or faster, we'll have a lot fewer reasons to buy it.

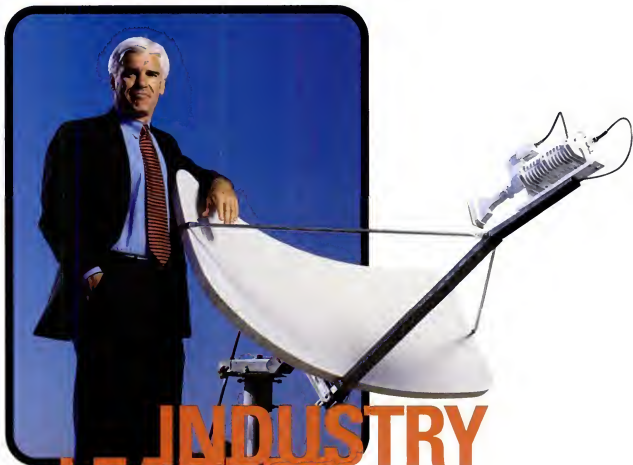
Who will run computers and networks?

Outsourcing may have waxed and waned over the past decade, but it will inevitably be the rule over time. There is little competitive advantage to be gained from running the best data center or the best darn network.

"Netsourcing," or the provision of IT applications over the Internet or other networks, will accelerate the trend (despite its uncanny resemblance to timesharing!). In a few years, CIOs will rarely see or touch the computers, routers, fiber-optic lines or other devices that provide information and processing cycles. The idea of managing your own data center will seem as foreign as owning your own proprietary power plant. Even the PCs we use will often be owned, configured and serviced by someone else. And as far as I'm concerned, it's a good thing that we will soon see the last of corporate IS types walking around with screwdrivers in their pockets.



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Think Tank

What will structure our work?

There's little doubt that computers are increasingly capable of presenting us with the information and knowledge we need to do daily tasks. The less creative the work, the more likely that is already true. For example, a majority of telemarketing workers today probably have their work structured by computer-driven scripts. Unless something changes, that process will begin to structure the work lives of stockbrokers, customer service representatives, and even systems analysts and managers. It will undoubtedly make the work process more efficient, but I for one simply don't want to take orders from a computer about what I should do next. I'm happy to use it as a tool, but I want to be the general contractor, the information integrator, the control program.

Will technology help us work more hours or less?

Ever the optimist, I'm voting for less. I think we'll start to realize soon that

information technology has thus far only made us work more. Unlike wiser Europeans, we Americans have taken the results of our productivity gains not in leisure but in increased consumption, making us have to work even harder to pay for it all. And IT has been our willing partner, allowing us to work at home, on vacation and in the car at any time of day. We now work longer hours than any other nation on earth. Shouldn't there be more to life?

Will IT continue to evolve as rapidly?

Probably not. I think we're living in a time in which IT has had an amazing run. But energy usually shifts from one technology to another. Much of the money and talent chasing IT will probably move to other technologies—biological or materials or even agricultural—and most likely some combination of all of them.

Will the Internet hype ever end?

Yes, mercifully, but only to a degree. All

major new technologies have had overly positive hype associated with them at the beginning, and eventually something else comes along. After all, just a few of us still subscribe to *Telegraph World* (I read it only on airplanes). It's already clear that e-business is just good business. The pace of Internet adoption will be so rapid that it will be a well-established aspect of business in a couple more years. But one important factor will keep the Internet and the Web on the front page: the drastic imbalance of information over human attention. I think this means that people and companies on the Web will continue to do interesting things to get our attention. When viewership starts slipping, no doubt some CIOs will be forced to pose naked on their sites just to create a buzz.

What kind of information technologies will predominate in the future?

My money is on entertainment-oriented technologies. Television and the Internet will merge—and you know what happens

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How will personal information be managed?

Over the past couple of years I've seen movies depicting a not-too-distant future in which malevolent entities—corporations or governments—know way too much about individuals and can manipulate their lives at will. It struck me as I viewed these flicks that there was nothing terribly implausible about this vision. In fact, almost all of the individual invasive acts could be performed successfully today, although with less speed and integration. This bit of cinematic futurism made me realize that unless we put on the brakes, eventually individual liberties are going to be in trouble. I think the United

States will ultimately join Europe in viewing this as a big issue and that companies and governments won't be allowed to act on much of what they learn about us. Of course, some groups will disobey these laws, which should keep us well supplied with scary movies.

Will corporations continue to be organized the way they are today?

Sort of. Big companies will exist to organize and sponsor major projects. But with the rise of the Internet and the continued growth of knowledge-based work, the majority of workers will be free agents who hook up with companies for projects and then move on. The primary affiliations for these workers will not be corporations but rather "guilds" of people who do similar types of work—"e-lancers," as MIT professor Thomas Malone calls them.

What won't change much at all?

Most things, fortunately, since I like life

as it is. People will continue to want to congregate in the same place on occasion. They'll still have fun and seek diversion. They will die after a hundred years or so (though we may have to force their exits to make room for the new kids). They will continue to have their own desires, hopes and goals— independent of what their organizations or their computers tell them. They'll continue to care more about food, clothing, shelter and the welfare of their families than almost anything else. Computers, if anything, will become more marginal and taken for granted, simply because they will be everywhere and in everything. **CEO**

Thomas H. Davenport is a professor of management information systems at Boston University School of Management and director of the Andersen Consulting Institute for Strategic Change. He welcomes reader comments at thomas.h.davenport@ac.com.

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Countdown to Rollover

Has the world done enough to prevent Y2K?

BY JOHN GANTZ

YOU'RE DONE. YOU'VE FOUND and fixed the date fields, installed the new software and filed compliance letters from your suppliers. You've put contingency plans in place, documented all remediation efforts and held meetings with the company lawyers. But, still, are you ready? And if you are ready, are the other companies on which you depend ready? And will your customers act rationally?

On an individual company basis, the answers depend on myriad issues, including the age of the software code base, the diligence with which the Y2K problem has been attacked, the skills and methods of those addressing the problem, and, yes, probably a little luck. But on an aggregate basis, U.S. businesses look well prepared. What's more, that preparation will pay off.

These are the key findings of a research project currently underway at International Data Corp., a market researcher based in Framingham, Mass., and a sister company to CIO Communications Inc. Known as Project Magellan, the effort captures years of IDC research surveying IT professionals and CIOs on their Y2K remediation efforts. In the project, IDC uses its global research data to forecast the impact that the millennium bug will have on the economies of more than 50 countries, countries where most multinational companies do business. The outlook is not pretty. (For more information, see "Globetrotting with Project Magellan," Page 52.)

But first, the good news. In the United States, we are well prepared. In the last five years, U.S. businesses have spent \$109 billion to fix the Y2K problem. And this includes only spending on staff, software, hardware

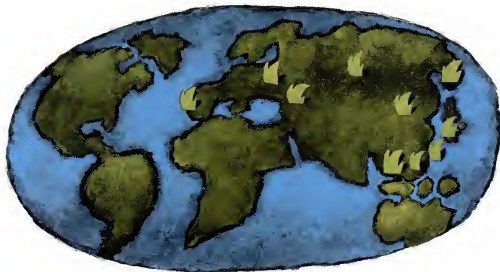
and services targeted specifically to Y2K. It excludes normal product upgrades or enhancements, unless they were rushed into place more than six months early.

As a result of that spending, 85 percent of the more than 1,000 companies responding to a recent IDC survey said they had completed Y2K remediation by Sept. 30; less than 3 percent expected to miss the deadline. Even better news: Large companies with complex environments were even further along and had conducted more extensive testing. You have done your homework. Good job.

Now the Bad News

That might be the end of it if many of us didn't work for international or global organizations. Here the story is a little different. While countries outside the United States have spent some \$149 billion to fix the Y2K problem, as a percentage of their overall spending on information technology, they have spent considerably less than our country has spent. We compared the relative spending in 1999 on fixing Y2K bugs in seven major regions of the world and found that the United States spent more last year to fix Y2K problems than it did this year and spent the same amount in 1997 as it did in 1999. Not so in other regions.

In Western Europe, for instance, corporations have spent only 60 percent as much as their U.S. counterparts on fixing the problem when measured relative to IT budgets. Even lower on the charts were developing regions like Latin America (18 percent), Eastern Europe (16 percent), the Middle East and Africa (26 percent combined). Asia-Pacific's figure (62 percent) would look worse, except that that number represents only 1999 spending, and the region, particularly Japan, has been playing catch-up.



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Year 2000 Challenge

Particularly worrisome, as other studies and government advisories have pointed out, are activities in developing countries. In a global survey of 15,000 businesses around the world early in 1999, the Project Magellan team found that over 90 percent of the companies surveyed in the developed world expected to be done with Y2K remediation by the new year. In the developing countries, that percentage was just less than 20 percent. In addition, more than 25 percent said they didn't think they had a Y2K problem to begin with. If you are running a multinational with remote offices, you already know the rest of the world is not as prepared as the United States.

What no one has done until now, however, is quantify what this means. We know how much work we've done to fix Y2K. Will that work pay off? What will be the impact of Y2K? Will, for instance, Deutsche Bank economist Ed Yardeni's prediction that there is a 70 percent chance that Y2K will cause a global recession come true? Or will Y2K blow over as calmly as did Sept. 9, 1999, the global positioning system 20-year date rollover and the U.S. government's new fiscal year?

The Metrics of Pain

How much pain will the Y2K bug inflict? The researchers and economists on Project Magellan puzzled first on how to measure its impact on the economy. When all was said and done, the simplest way seemed to be in revenues lost as a result of downtime. These would have to be revenues that weren't just shifted from one company to another, or from a week in January to one in February, and so on. But they could be, and will be, revenues lost throughout the year, not just in the first days of the year 2000.

Using the results of several major research studies, ongoing information on automation levels and IT budgets in different countries, the Project Magellan team developed a model for the impact of Y2K. Out of this model came three scenarios that varied based on how Y2K problems are likely to travel through the economy. In the Ho-Hum Scenario, problems are relatively well contained and the effects are isolated

Globetrotting with Project Magellan

Where in the world will Y2K cause hiccups?

LAUNCHED BY INTERNATIONAL DATA CORP. THIS PAST SUMMER, Project Magellan is a year-long research project assessing Y2K readiness, impact and recovery efforts around the globe. Using a series of multinational surveys, as well as IDC statistics and data on over 50 countries, the project has developed a complete model of Y2K remediation spending around the globe as well as a forecast of the impact that Y2K will have on the global economy (and that of the more than 50 countries).

A key part of the project is a network of IDC analysts and industry contacts that will report in real-time on the impact of Y2K as year 2000 begins at the International Date Line and travels west. The analysts will report to Project Magellan headquarters (by phone and Internet), where the project team will adjust the assessment of Y2K impact in real-time. For more information on Project Magellan, visit www.idc.com or call 888 IDC-Y2KK.

—J. Gantz

to individual companies. In the Cascade Scenario, lost revenues cascade through the economy similar to the way value-add is developed in the economy. One company's lost dollar is another company's lost 70 cents. Problems diminish as they propagate from company to company. In the Cascading Cascade Scenario, lost revenues filter through the economy twice as far as they did in the previous scenario. But problems' effects ultimately dwindle. One company's Y2K problems—especially in billing and supply chain systems—affect seven other companies before petering out.

A fourth scenario not computed in the model might best be termed the "civilization ends as we know it" scenario. This is the one where problems propagate through the economy and get worse as they go along—one company's dollar of lost revenue is another's lost \$10 and so on. The Project Magellan team considers the probability of this to be so remote that it's not even worth calculating. In this scenario, CIOs would have

been better off spending their Y2K remediation dollars on lottery tickets.

Was It Worth It?

Based on our research, IDC believes the Cascade Scenario will prevail. If so, the world economy will lose \$19.2 billion to Y2K bugs in the year 2000, a pittance compared with the money spent fixing the bugs and on the overall world economy, which is measured in the tens of trillions of dollars. (The more drastic Cascading Cascade Scenario would take more than \$60 billion out of the world economy, still a small amount on a global scale.) Losses by region fluctuate. Despite the work done to date, the United States has such an automated economy that what few problems are left will have more impact than problems in less automated economies (total: \$4.9 billion). Latin America's Y2K losses will outstrip its share of total IT spending by a large margin (\$1.2 billion).

An older software base and fairly automated economies in Japan and

Australia drive the Y2K losses in Asia-Pacific (\$7.4 billion) past those of the United States, accentuated by the prevalence of pirated software in the lesser developed Asia-Pacific countries. Y2K problems in Eastern Europe (\$1.1 billion), especially Russia, which are expected to be widespread, will be offset by the fact that most of the local economies are not dependent on computers.

The 10 countries of the 50 largest that will be the most affected by Y2K as measured as a percentage of their economies include Bulgaria, Hong Kong, Japan, Korea, the People's Republic of China, Portugal, Romania, Russia, Taiwan and Vietnam. Note, however, that even in the countries hardest hit, losses will be less than 0.1 percent of the year 2000 economy.

If the Project Magellan forecast comes to pass, you'll soon be breathing a sigh of relief. Staff will be taking comp

time, and vendors will be beating down your door to discuss new projects. The Y2K problem will fade, no worse a memory than a major operating system upgrade from the IBM System 360 to the System 370 was in the old days. In

The probability of the "civilization ends as we know it" scenario is so remote that it's not even worth calculating.

fact, more than likely there will be questions on whether the whole Y2K "scare" was justified. That's the irony of it. The more smoothly we enter the next millennium, the more that management, pundits and the public will second-guess whether the last five years of remediation were worth it.

Once the final impact is tallied, the Project Magellan team will turn to its

Y2K impact model to run ROI calculations. In a first pass, the team determined that if the scenarios don't change—just the number of bugs and the time to fix them—then all the money spent to fix Y2K will be matched by revenues that could have been lost but weren't. Fixing Y2K bugs then was an insurance policy, with some side benefits triggered by the system upgrades required.

But quite likely, if no Y2K efforts had been undertaken, then we would be favoring a different scenario, one where problems compound one another in accelerating fashion. In that case, we wouldn't just be looking for jobs after Y2K. We might be looking for food, gasoline and batteries. **CEO**

John Gantz is chief research officer for IDC in Framingham, Mass. He can be reached at jgantz@idc.com.

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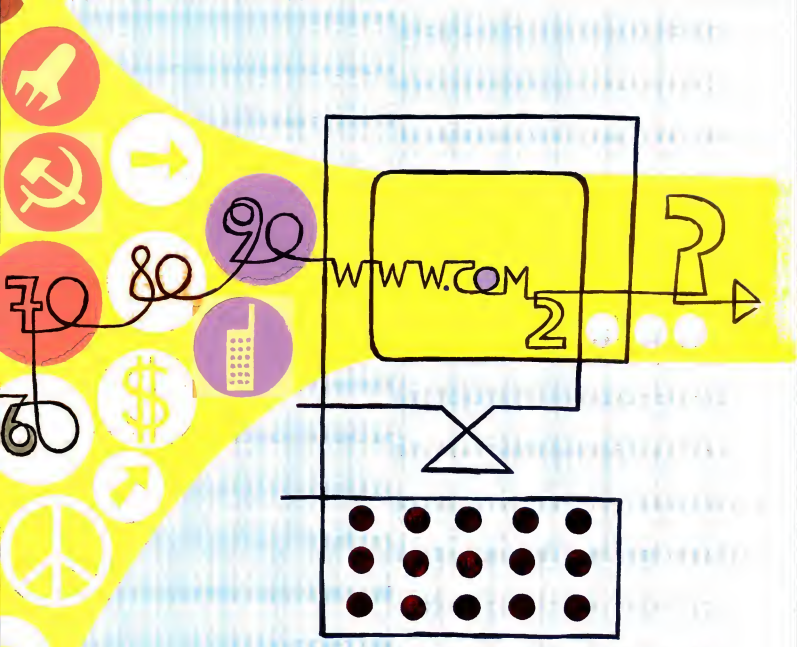
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IT inventions and trends of the last 30 years give hope and inspiration for the next 30

WE'VE GOT TO ADMIT I.T.'S

GETTING

BY POLLY SCHNEIDER

"The further backward you look, the further forward you can see."

—WINSTON CHURCHILL

It may have taken 20 years for the personal computer to truly capture the imagination of the world, but these days, the future is coming at us at lightning speed. The first commercial Web browsers have been on the market for only four years, and already they are ubiquitous. In a relatively brief period of time, every business model on the planet has been turned on its head. With the pace of technological change destined only to increase, it's imperative to prepare for an unpredictable future. But how? It's hard to know if it's better to talk to colleagues, attend conferences, read books by futurists or simply visit a tarot card reader.

Ironically enough, we think you'll learn much about the future by taking a look at the past. This special issue's journey begins 30 years ago at the dawn of the computing age as we know it, when developments that would change the business world began to appear: the Internet (ARPAnet back then), Ethernet networks, IBM's System 370 mainframe, the Alto personal computer. Technology hot spots such as Xerox PARC emerged, where many of the new industry's founders honed their skills. Before long, scrappy young companies opened their doors and began to populate an indescribable, dusty zone of land south of San Francisco in a place we now call Silicon Valley.

By looking at the IT inventions and trends that shaped the last three decades, we hope to illuminate what worked, what didn't and how we can take those lessons forward into the next 30 years. Senior Editor Anne Stuart provides a glimpse of how information technology has transformed two information-driven operations at Visa USA and *The Wall Street Journal* (Page 88). Before computerization, Visa used to store customer credit data in huge manuals that call center operators had to page through hundreds of times a day to approve purchases. Today, with 8 billion transactions a day, it is building a global network capable of supporting the entire planet's daily affairs.

Contributing Writer Tracy Mayor takes us down memory lane in "Inventing the Enterprise" (Page 126), where the heavyweights behind the fundamental computing concepts of today wax philosophical on how their inventions came to light. For instance, Lotus Notes creator Ray Ozzie reveals the social motivations behind this pervasive business application: "Call it groupware or messaging or whatever. It was relationships I was after," says Ozzie.

Realizing that you may be up to your ears in millennial predictions by now, we made sure that the forward-looking stories in our package offered sound advice—not far-out musings about talking refrigerators and intergalactic corporations. In "Making Beautiful Music," Contributing Writer Bill Roberts explores the present and future states of collaboration—within the enterprise, with customers and with suppliers (Page 106). These knowledge leaders from DuPont, Lands' End and others share prescient tips for helping users take full advantage of the new tools, along with advice on surviving the ensuing cultural changes. "Companies that don't figure out how to collaborate better will be the first casualties of the new century," Roberts warns.

In "Don't Stop Thinkin' About Tomorrow," Staff Writer Meredith Levinson takes us into the world of scenario planning, tracking the adventures of a Cleveland bank as it engages its employees in a week-long workshop to reinvent corporate strategy (Page 70).

And if you think the Net generation has little to do with your future plans in IT, Features Editor Meg Mitchell will tell you how today's kids—and the new media they adore—are rewriting the rules of education, interaction and working (Page 158). "Kids who have never known a world without computers, students who have never written a letter by hand, will be your employees (or your customer, or your boss)," she observes. "If you're not ready to serve them—in whatever capacity they demand—it's likely your competitor will be."

Optimistically speaking, this future virtual world will enhance the quality of life for people of all races and cultures, and it will be good for business. Before we know it, every country will have high-speed, rich connections

to the Internet, which could level the playing field for nations that are isolated and disadvantaged today due to a lack of technology or exports. There will be more jobs overall, based on the unlimited supply of information and the unlimited potential of value and services it will create. But

some will inevitably lose out, unable to learn the skills necessary to survive digitally. Are you ready for 2030?

Senior Writer Polly Schneider can be reached at pschneider@cio.com.

decoding the past
inventing the FUTURE

BETTER



CIOs overestimate progress in the short term and underestimate progress in the long term, says former Dell Computer CIO Jerry Gregoire.

A blizzard of new technologies and business pressures swirl around CIOs.

Can understanding the past help CIOs endure the storms of the future? ♦

STORMY WEATHER

PERSONAL COMPUTING PIONEER ALAN Kay once said, "The best way to predict the future is to invent it." But CIOs face a distinctly different challenge: They scan the inventions of the day and decide which have the potential to shape their businesses' future and which will never meet the inventors' expectations.

Looking back at the computer industry over the past 30 years, it's easy to see which technologies have fundamentally changed the way we do business, such as the personal computer and the Web. It's also easy to see which technologies never lived up to their promise, such as computer-aided software engineering (CASE) and artificial intelligence (AI). Yet it is still difficult for CIOs to forecast which core technologies—or even which vendors and products—will fall into the former category and which will fall into the latter.

Why? One reason may simply be vendor hype, combined with a technology press that blows hot, then cold, over the latest buzzwords and gizmos. Today's headlines rave about PDAs and outsourced applications; yesterday's raved about network computers and massive ERP installations. Who knows what technologies will be blessed and cursed tomorrow? Another reason may be that CIOs themselves can get too easily seduced by new technology that doesn't live up to its promise in the time frame they expect;

conversely, they may not be able to foresee a technology's impact further down the road. "We CIOs overestimate progress in the short term and underestimate progress in the long term," says Jerry Gregoire, former CIO of Dell Computer Corp. in Round Rock, Texas.

Gregoire includes himself in this description. Though he's hesitant to admit it, when the first color PC monitors came out, his first thought was, "What in the world do we need color for?" Then there's the time about 10 years ago, while he was CIO at Pepsi, that he backed an aggressive plan to add voice recognition capability to delivery truck drivers' onboard computers so that the drivers could have safe, hands-free computer access while they were on the road. Voice recognition on PCs was not quite ready for prime time, but Gregoire was sure that it would be soon enough. "When we started the project, I was thinking, 'They're going to get these problems solved and we're going to be ready,'" Gregoire says. He learned the unfortunate lesson of what can hap-

BY SARI KALIN

ILLUSTRATIONS BY ALLISON SEIFFER

decoding
the past
inventing the
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pen when the completion of a project hinges on an immature technology: When Pepsi was ready to roll, video recognition wasn't. "It was such a cool idea," Gregoire says, with a reflective tone in his voice. "We spent a lot of money on it, but we never solved it."

Ten years ago, Gregoire says, he could have never imagined that by 1999, video recognition on PCs would have made as little progress as it has. And 10 years ago, no CIO would have predicted that the Internet—then largely the domain of students and scientists—would one day make big-company CEOs worry about getting "Amazoned" by dot-com competition. Even inventors themselves sometimes have difficulty predicting the most important long-term business and social impact of their inventions. Thomas Edison believed that the phonograph's most important contribution would be to revolutionize business dictation. The technology was, in fact, used for dictation, but as we all know now, it had a revolutionary impact on the music and entertainment industries.

Even though iron-clad predictions may not be possible—or desirable—to make, CIOs can draw insights from the past and present to help them face the ever-increasing onslaught of new technologies and new business pressures in the future. This story will take a look at some of those lessons and at some of the technologies CIOs are betting on in the future.

Taming Technology, Then and Now

Thirty years ago, the CIO title didn't exist. But those executives who were responsible for a company's IS operations could not have imagined the increased technological firepower—and increased flexibility—available to CIOs today (see "Formative Years," Page 88). In some ways, technological advances over the past 30 years have made the CIO's job easier. Take the exponential increases in computing power available at ever-lower prices. Paul M. Lemerise, CIO and COO of Web startup Wineshopper.com in San Francisco, recalls his biggest worry during his days as a vice president of MIS for Stride Rite Corp. some 20 years ago: figuring out how much mainframe capacity he was going to need over the next two years. "Every two years the life cycle of

one [IBM] series would come to an end," Lemerise says. "You were trying to stay current with the technology because you wanted to get the biggest bang for the dollar and plan your capacity moves so that you had enough left for what the [business side] wanted to do next."

Woe to the IS leader who made a mistake in capacity planning and had to go before the board and ask for more money. But in the old days, Lemerise says, long-term planning was nearly impossible since there weren't any good system tools—he couldn't tell how much capacity an application needed until he loaded it. Flash forward 20 years to Wineshopper.com, and Lemerise has none of those worries: Wineshopper.com's hardware engineers

have overengineered its Web site and use several different tools to stress-test it. If demand spikes (as is often the case on the Web) and the site needs extra capacity, all it takes is a phone call to the facility that hosts Wineshopper.com's production site. Twelve hours later—only four hours of which are needed to obtain the hardware itself—another two-CPU server is up and running. Wineshopper.com owns the capacity once it's turned on, so it's not exactly capacity-on-demand, Lemerise says. But it is a huge improvement over the way things were early in his career. "It's a whole different world," he says.

Yet that world brings a different set of challenges, chief among them the speed with which vendors roll out new prod-

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METLIFE, YOU'RE DEALING WITH 15 TO 20 FIRMS ON A STRATEGIC BASIS.

ucts. "There's so much new technology introduced, sometimes every three months," Lemerise says. "If you're not on top of it, you can make a business decision that can lock you into a technology that's older." Plus, CIOs also now must deal with a much more fragmented vendor landscape. James M. Logan, CIO of Metropolitan Life Insurance Co. in New York City, recalls that decades ago, companies like MetLife would have two strategic technology partners: AT&T Corp. and IBM Corp. "Today, you're dealing with 10, 15 or 20 firms on a strategic basis," Logan says. "It requires an awful lot of time and attention...sitting down and talking to them about what their business is about."

Choosing Relationships and Risks

To keep up the care and feeding of strategic relationships, Logan diffuses

the responsibility for those relationships across his IS organization—people responsible for application development maintain relationships with the application development vendors and stay on top of those new technologies. Lemerise, at his minimally staffed startup, doesn't have that luxury. He relies on advice from colleagues to find the vendors he needs; once he gets recommendations from his colleagues, he invites two vendors in for presentations (there's never enough time to meet with three) and makes his decision within a day. If he let himself, Lemerise says, he could second-guess every technology decision he makes. Instead, he has resigned himself to the fact that he will never have all the information he needs to make the best decision. "I'm going to make the best decision I can with what I have at the time," he says.

There are ways that CIOs can hedge their technology bets and decrease their risks. Pilot projects are one way to determine whether a technology has potential; at Maytag Corp., Edward Wojciechowski, corporate vice president of IT, is piloting Linux, while at Applied Industrial Technologies Inc. in Cleveland, Vice President of IS James Hopper's e-commerce developers have been early experimenters with extensible markup language (XML), which lets developers write custom tags to identify objects and is seen as a linchpin technology for e-commerce in the future. But some CIOs may opt to wait a little longer to deploy cutting-edge technology. Back in September, when Gregoire was still CIO at Dell, business was growing so quickly that he felt he couldn't risk any downtime. Dell was a beta site for Windows 2000, but Gregoire didn't rush to deploy the new OS in Dell's most mission-critical applications. "In the end, there's a lot less value in being on the bleeding edge and a lot more value in uptime and reliability," Gregoire says.

One way to decide when and how to deploy a given technology is to take a business strategic approach, according to Geoffrey Moore, chairman and founder of The Chasm Group in San Mateo, Calif., and author of *The Gorilla Game: An Investor's Guide to*

Picking Winners in High Technology (HarperCollins Publishers Inc., 1998). That approach calls for the CIO to distinguish between technologies that will give his or her company a competitive edge, which Moore calls core technologies, and technologies that are not as strategically important, which he calls context technologies. Core technologies should be handled in-house with in-house IS talent; context technologies should be outsourced. "IT resources are so scarce, for you to spend an ounce of internal resources on something that doesn't contribute to your core strategy is increasingly, going forward, a flat-out mistake," says Moore.

Moore is quick to point out that a given technology might be core at one company and context at another. Making the distinction between core and context technologies can actually help CIOs



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decide whether to risk being an early adopter or to hang back and wait. With core technologies, Moore advises CIOs to be early-to-middle adopters, that is, to be willing to take risks on state-of-the-art technology even before a clear winner, or "gorilla," emerges because their companies can get the biggest potential payoff by being ahead of the curve in an area that is key to their competitive advantage. They should be late adopters of context technologies and stick with the gorillas because it doesn't make sense to take big risks with a technology that won't deliver a big competitive advantage.

Adapting to a Changing Role

Moore's advice to CIOs underscores a change in the role of CIO from that of pure technologist to that of business strategist (see "Blues Survivors," Page 178). For some CIOs, adapting to that change and being able to use technology to bring about organizational change will be the biggest challenge they face over the coming years. "That's 50 times harder than just playing with the technology," says John Keast, CIO of PG&E Corp. in San Francisco.

The change from technologist to strategist—and the increasing pressure to demonstrate IT value that goes hand in hand with that shift—has implications for the way CIOs deploy technology too. Gone are the days of multiyear application development and implementations, some CIOs say:

Such projects take too long to demonstrate their business value. Keith Powell, CIO of Nortel Networks Corp. in Brampton, Ontario, says he learned his lesson about the pitfalls of poky implementations from his experience rolling out an ERP package from Baan. "It took us about 18 months before we really started to get anything that you could translate into business impact," Powell says. "You had everybody champing at the bit to get the benefit of the new system." The project took longer than he expected because of the time spent customizing the product to interface with legacy systems and to meet the needs of existing business processes. Next time, Powell says, he would not undertake this kind of packaged software implementa-



◆ NORTEL NETWORKS CIO KEITH POWELL SAYS EVERYONE WAS

CHAMPING AT THE BIT TO GET BENEFIT OUT

OF AN ERP IMPLEMENTATION, BUT IT WAS 18 MONTHS BEFORE THERE WAS ANY BUSINESS IMPACT.

tion without a commitment from all the players that they would "do whatever we need to do to fit with it."

For an e-commerce effort, the need for speed is even greater; if a new feature takes too long to deliver, there's a risk that the business needs may have changed or that the underlying technology will be tired by the time it is rolled out. That's why Powell has put Nortel's e-commerce efforts on a schedule of three-month, or "Web year," deliverables. "We talk about Web years and hours and days to implement things, as opposed to talking in months and years," Powell says. "Sometimes you have to take some risks in implementation...as opposed to getting it all nailed down perfectly and then moving forward."

Even with all the talk about the new role of the CIO, Maytag's Wojciechowski believes some CIOs are still starry-eyed technologists who spend too much time "chasing rainbows" and not enough time demonstrating business value. "IT has got to stop being a gold speculator and start developing methods for measuring IT value and IT return," Wojciechowski says. "Frankly, I'm disappointed in my chosen profession. I think IT in general is too focused on the technology and not on delivering a solid business foundation." What's Wojciechowski's advice for increasing credibility? First: Never have a backlog. Another way is to challenge user communities to see if they are using whatever systems they asked for two years ago. "If they're

A man in a brown coat stands in a library filled with bookshelves. He is holding a sign that reads: "It takes powerful software to reorder books from Boston the minute they're sold in Paris. That's the software IBM makes." In the foreground, a woman with short brown hair is seen from the back, looking towards the man. The library has high ceilings, a chandelier, and a wooden staircase with a book tray on it. The overall atmosphere is warm and intellectual.

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not using them, what makes you think they're going to use this new request any more effectively than the prior ones," Wojciechowski says.

Keeping an Eye on the Future

Despite the difficulty of making predictions, today's CIOs do have a sense of what technologies and capabilities will be important to businesses of the future. E-commerce is at the top of most everyone's list—not just on the front end for relationships with customers, but also on the back end, throughout the entire supply chain. Companies will also need to do a better job of harvesting and analyzing customer data so that they can anticipate where the market is going and not just react to it. Nortel's Powell sees CIOs

increasingly outsourcing applications and infrastructure. Gregoire believes CIOs will, as Dell has, re-architect their internal systems using an Internet-style architecture to give them the flexibility the business side demands. At Dell, that has meant developing a multitier architecture that links to back-end applications but buffers users from the complexity through a Web interface. "I'm convinced that companies are going to move away from these tightly coupled, highly integrated application suites like you see in ERP systems," Gregoire says.

CIOs will also have to contend with what IBM Research's Ambuj Goyal calls pervasive computing, the notion that computing will no longer just be confined to the desktop. People today think of

PDA's, smart phones and wearable computers as simply "cool devices," Goyal says. But smart CIOs should be thinking about how the ability to stay in constant contact with employees, partners and customers can change their business models and open up new opportunities. He points to IBM customer Safeway PLC supermarkets in the United Kingdom, which is pilot testing a handheld device that lets customers make a grocery list by scanning bar codes from items they need. For example, when they run out of juice, they can scan the bottle before putting it in the trash. When the customer is ready to go to the market, he or she connects the device to a phone line and submits a grocery list; a store clerk then gathers the groceries so that they are ready to go when the customer arrives. "Safeway is building a better customer relationship," says Goyal, vice president of systems and software and head of computer science at IBM Research in Hawthorne, N.Y. "They can also improve their logistics."

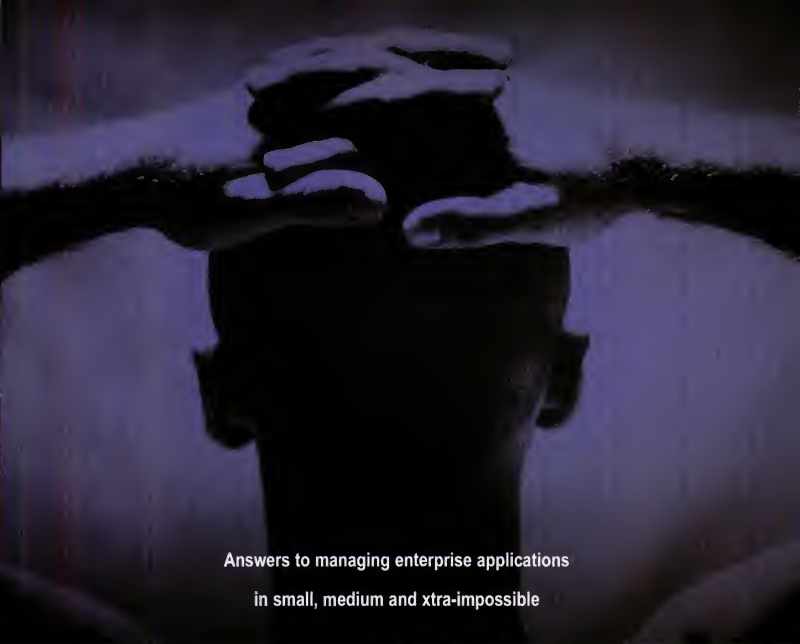
In the long term, author Michael Dertouzos also envisions computing and communications becoming so pervasive that you will not see it anymore and that it will dramatically alter the role of the CIO from one of iron-fisted control over technology to that of technology enabler. He makes this analogy: The motor, once the cutting edge of Industrial Age technology, is now something we use without giving much thought to its being a motor. "You think of the refrigerator," says Dertouzos, director of MIT's Laboratory for Computer Science in Cambridge, Mass. "You don't think of the compressing motor that cools your food." The same will be true for IT. There will still be a role for CIOs, since information is so important. But centralized control over hardware and software will likely decrease, even fade away. "The centralization starts getting smaller so that the role of the CIO is no longer the czar of information but more a resource for helping people do their jobs with information technology," Dertouzos says. "You don't need a chief refrigerator officer to tell you how to run your refrigerator." **CEO**

Senior Writer Sari Kalin can be reached at skalin@cio.com.

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Inventing the future isn't easy, but there are ways to diminish the uncertainty through scenario planning ♦

DON'T STOP THINKIN' ABOUT TOMORROW

NATIONAL CITY CORP. TO REORGANIZE:
*Bank Abandons Regional Structure to
Focus on One-to-One Customer Service.*

Was that really the newspaper headline National City IS chief Jon Gorney wanted to see? He wasn't sure. Gorney's no soothsayer, but during the summer

of 1996, the executive vice president in charge of operations and IS at the Cleveland-based bank found himself wishing for a crystal ball as he contemplated deploying a \$40 million investment in a customer information system. Unfortunately, that wasn't the only uncertainty he was anticipating.

National City was confronting three challenges common to any business in

tough times: It needed new ways to generate earnings, it faced increasing competition for market share, and the Internet was threatening to turn the world upside down. National City saw the customer information system the bank was developing with IBM Corp. as a solution to these problems. The bank

hoped to develop new, high-revenue products, tailor programs for customers and cross-sell products to appropriate customers. But to design it, Gorney had to know what kind of information the system would be aggregating. Would it track information about the products the bank offered or the people who bought them? If it was product-focused, it would have to include detailed descriptions of each financial service, whether credit cards or mortgages. If the system was customer-focused, it would track whether they used ATMs, branch offices or call centers, and indicate demographics in order to build profiles. Furthermore, Gorney would need to set up business rules to determine customer profitability.

Gorney quickly realized that he simply could not answer these questions because the answers were linked to a larger issue: He didn't have a clear sense of the bank's strategic direction. The company's newly installed chairman and CEO, David A. Daberkof, had determined that National City and its com-

BY MERIDITH LEVINSON

ILLUSTRATION BY ANN FIELD

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YOU CAN'T ANSWER QUESTIONS about your company's future with a Magic 8 Ball, but with scenario planning you can devise strategies based on what you can discern about the future. Read this story to learn how scenario planning can

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- ♦ Make you aware of the factors influencing your decisions
- ♦ Provide you and your colleagues with a common vocabulary for discussing strategies

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petitors like Wells Fargo & Co. and Bank One Corp. couldn't rely on mergers and acquisitions as their sole growth strategy. But if not that, then what?

Even though strategy had never been information technology's bailiwick, Gorney felt compelled to step forward. The alternative was to waste \$40 million on a system that wasn't aligned with the company's goals. He brought his questions about the bank's long-term survival to Daberk. "I told him that we had significant choices to make in terms of technology investments, and that we couldn't afford to be wrong," he says. Because Daberk understood what technology could do for a business, he sent Gorney off to find a solution.

To do so, Gorney needed an approach to strategic planning that was different from the issues-based planning the bank had done in the past. That had left out participants from the IT and operations departments, and was vague on how goals would be achieved. Gorney needed something more focused, more creative and more detailed. He wanted to bring together representatives from every department and line of business within National City. On IBM's recommendation, he contacted Northeast Consulting Resources Inc. (NCRI), a Boston-based company offering scenario planning workshops. "Scenario planning made more sense for the bank because it worked with very specific outcomes [of the bank's future]," he explains. Though the price tag was just under a half-million dollars for a three-day workshop, Gorney hired NCRI in summer 1996.

Scenario planning can work for any company, provided that company has the time, resources and commitment of its executive team. An exercise in contingency thinking, it was developed during the Cold War to prepare for nuclear annihilation (see *Dr. Strangelove*) and was pioneered in the corporate world by Royal Dutch Shell during the oil crisis of 1973. Today, organizations like the United States Postal Service and brick-and-mortar retailers use scenario planning to understand the effects of external factors on their businesses, whether they be technology driven (e-mail and e-commerce), political (deregulation) or economic (sudden down-

turns). With technology driving the pace of change and IT increasingly viewed as the key to staying competitive, the CIO is the logical choice to introduce scenario planning.

Define the Choices

Gorney's first order of business was to select two managers from his IT staff to prepare for the three-day workshop to be facilitated by NCRI. They spent several weeks researching the banking in-



dust and tracking technology trends (see "Seven Steps Toward Successful Scenario Planning," Page 74). Then they interviewed 50 executives from each of National City's departments to find out how they used technology, what they thought the bank's strategic direction was and how they thought the bank could best pursue it. Peter Schwartz, chairman and cofounder of the Global Business Network, a company based in Emeryville, Calif., that specializes in scenario planning, says that in order to create a vision for the future that makes sense to the company, you have to get into the minds of the decision-makers.

From these interviews, they developed three of what NCRI calls "end-states," or alternative visions of the future. Among them were

• National City improves its customer focus and develops a relationship-based strategy. This means that the

bank tailors its services (financial planning, mortgages, mutual funds) to individual customer needs. Though this was the major industry trend, the business model was complex and costly to pursue.

♦ National City specializes solely in products. The bank would concentrate on streamlining the development and delivery of financial services, whether they be mortgages or credit cards. This would significantly reduce costs but would do so at the risk of losing customers who were looking for a company to serve all their financial needs.

♦ National City launches a separate online bank under a different brand (similar to what Bank One has done with WingspanBank.com). This cyberbank would offer its customers another delivery channel but would also compete with National City's own brick-and-mortar bank.

After narrowing the bank's possible future to those three, the team compiled a list of 150 internal and external events that might influence any of the outcomes. The events could be regulatory issues such as a bill permitting alliances between banks, securities firms and insurance companies (which actually happened in 1997 with the Financial Services Competition Act) or technology trends such as the widespread use of the Internet for conducting financial transactions. Written as news headlines with accompanying descriptions, such as "Demand for Real-Time Information Skyrockets: People Visit Banks for Advice, Not Cash," these events were later used to create the scenarios that would lead to each outcome.

Debate the Visions

Once the core team had completed its research, conducted all interviews and drawn up potential futures, it was time to bring in the participants. On the first day of the three-day workshop, 24 executives from National City's banks, the IT department and the chairman's office—some excited, some skeptical—gathered in a conference room. They were divided into four groups and told to rank all 150 events based on how likely they thought they were to occur. Among the events deemed highly probable were companies investing in com-



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prehensive security infrastructures and customers using online financial services to get customized information and advice. They regarded as highly unlikely a scenario predicting that by 1999 one-third of U.S. households would be using electronic financial services.

According to NCRI, the purpose of this part of the workshop is to sensitize participants to the assumptions and biases they have about various issues. These assumptions can be about the way a company or industry operates and can lead executives to make critical decisions in a vacuum, without considering, for example, the ramifications of cultural trends or economic shifts.

If participants were split on the likelihood of an event, they attempted to

reach a consensus. One dispute was about whether customers would do business with a bank based on price or service. (The group never resolved this one, so they left it as an unknown and worked it into their scenario as such.)

Next, each group was assigned a possible scenario (the three outlined previously) and over two days were charged with analyzing how the various events that they ranked might influence it. "This scenario-based planning exercise recognizes that an end-state four or five years from today is really not just a single end-state but a journey from today through a lot of events leading up to that endpoint," says Robert Rupp, director of National City's consolidation services and a member of the core team.

The team working on the customer-focused scenario came up with the following events that might lead to it: forming alliances with companies outside the retail banking industry, integrating financial information for customers to become a one-stop shop for their financial needs, and restructuring National City around customer segments rather than regions (the bank had 1,300 branches in six states). They also took into account trends that might prevent them from becoming customer focused, such as the Internet conditioning consumers to care less about personal service and more about price.

The groups then presented their scenarios and tried to convince the other participants that their vision was the most plausible. Gorney warns that this part of the exercise can be difficult. "Scenario planning requires role playing, which can be uncomfortable since it forces people to assume a view that may be contrary to what they initially believe," he says. They do, however, have the opportunity to voice their personal opinions after their presentation.

Finally, participants discussed which outcome was best for the bank. There was significant debate over whether National City could really develop one-to-one relationships with its customers. That would involve intimately knowing which product or service was right for an individual customer by tracking her financial activity. It would also involve highly targeted marketing campaigns. The alternative was to focus on improving all their products and delivering them as efficiently as possible. Each line of business would push its products without regard to whether it was the right thing for a particular customer.

Though the group started to agree on increasing its customer focus rather than becoming product-centered, it was ultimately up to Daberk, who joined the session on the last day, to make the call. He decided that National City would pursue the customer-centric model because he believes that this is ultimately where the industry is going.

Make It Real

Since National City decided to go down the full service road, it has

◆ Implemented a data warehouse that

Seven Steps Toward Successful Scenario Planning

Interested in a scenario planning session for your company?

Here's a framework you can follow.

BEFORE THE WORKSHOP

1. Build end-states and events

(six to eight weeks)

A core team of three to five managers interviews internal and external experts to develop four to five alternative visions of the future and 100 to 200 events that might lead to that future.

2. Rank outcomes (one week)

Before the workshop, each participant ranks outcomes based on how attainable and desirable they believe they are.

DURING THE WORKSHOP

3. Assess the likelihood of events

(three to four hours)

Participants are divided into teams equal to the number of outcomes, and each team ranks all events based on their probability.

4. Build and advocate scenarios

(eight to 10 hours)

Each team builds a scenario around an outcome, linking it to the current state of the industry or the world. The team members then present their scenario to try to convince the other teams of the plausibility of their argument and to share the insights they gained while building it.

5. Revise rankings (30 minutes)

After listening to each team's defense of its scenario, participants rank outcomes based on the same criteria used in component two.

6. Compare old and new thinking

(one hour)

Participants engage in a discussion led by the core team about the changes in their perceptions.

7. Develop event-driven strategy

(four to five hours)

The group selects a desirable outcome and develops a game plan to achieve it.

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allows the bank to build customer profiles. These profiles are used to identify the products and services appropriate for each individual.

- ◆ Launched new sales, development and marketing programs that target specific products and services to specific customers.

- ◆ Developed a technology capability

forced us to ask the business side specific questions about the level of customization they wanted and what they mean when they say 'a market of one.'" Once Gorney had these answers, he knew how to spend that \$40 million on a customer information system with the right specifications for determining profitability and cross-selling opportunities, and for

technology needed to support new initiatives, he now knows for certain that his IT strategy is aligned with the business. And should the tides turn unexpectedly in his industry, Gorney has the tools to recognize the omens of change and adapt his strategy accordingly. For instance, he's keeping tabs on the rate of network cable installations across the

The Pros and Cons of Scenario Planning

You can't get an answer if you don't know the question

The fundamental difference between scenarios and other forms of strategic planning is that scenario planning accounts for a range of visions, while traditional forms of strategic thinking, such as forecasting, only consider one version of the future.

Whereas forecasting makes predictions based on a company's past performance or by previous trends, scenario planning acknowledges that the future is unpredictable and takes a company's uncertainty about the future into account.

There are, of course, drawbacks to scenario planning. "This is not something that can be done quick and dirty and cranked out by a junior staffer. It takes serious research, significant resources, time and engagement [from the management team]," says Peter Schwartz, cofounder and chairman of the Emeryville, Calif.-based Global Business Network, a company specializing in scenario planning. To do it well, he says, companies must first understand the question or decision they're dealing with.

If getting buy-in from the executive team for an exercise like this is going to be like shooting rubber bands at the stars, National City Corp. IS chief Jon Gorney offers this advice: "Try to put some strong scenarios together. Show them that it's not clear where the company is headed. Tell them that you need to ensure that the business units are in agreement with this direction. Assure them that this scenario planning process is detailed and focused."

—M. Levinson

that enables the bank to deliver those customized products across multiple channels such as ATMs, branch locations, call centers and a Web site.

- ◆ Introduced data mining procedures to identify and retain the bank's most profitable customers.

- ◆ Restructured the bank along lines of business rather than geography.

Keep It Going

With scenario planning, National City may still not ultimately control its fate, but at least all its business units now share a single strategic vision. "Scenario planning helped [the IT group] understand the issues the business heads handle every day," says Gorney. "Now, we have a better appreciation for the revenue side of the business because we had to get specific. We had to get down to detailed end-states. To just say that we want to be a customer-focused organization is pretty broad. Scenario planning

developing customized programs.

Participants on the business side also gained valuable perspective. Jim Bell, the bank's executive vice president, had spent 15 years primarily on the corporate banking side and three years as CEO of National City's bank in Kentucky. "I got a crash course in the issues facing our brokerage unit and retail practice," he says, "as well as an understanding of the technology infrastructure needed to support those businesses that I didn't get in my normal activities as CEO."

The exercise "established a shorthand or common nomenclature for some generic strategies that still facilitates communication today," says Bell. Rupp concurs. "It is amazing how after these sessions people would keep referring to the conversations and the terms we used, like cyberbank, as we started to talk about implementing programs."

While Gorney is busy rolling out the

United States to determine the effect it might have on electronic banking.

Because of the exercise, the company now draws up a yearly set of critical initiatives around its strategy, such as a process to identify a customer ready to leave the bank. Now National City is able to recognize the signs that a customer is about to leave and can take proactive measures to retain that customer before it's too late.

"Scenarios help companies recognize the future as it unfolds so that they can see the signals of change in a more timely way," says GBN's Schwartz. "It enables you to manage risk differently. Because you understand your risks better, having recognized unpredictabilities, you have more maneuvering room and can act with more confidence toward the future."

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In his newest book, *Building Wealth*, noted economist Lester Thurow discusses the road to riches in a knowledge-based economy. This excerpt poses the question: Can intellectual property be protected in an age of connectivity? ♦

THE WEALTH OF KNOWLEDGE



*Building Wealth: The New Rules
for Individuals, Companies
and Nations in a
Knowledge-Based Economy*

By Lester C. Thurow
HarperCollins Publishers Inc., \$27.50

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SKILLS AND KNOWLEDGE HAVE become the only source of sustainable long-term competitive advantage.

Intellectual property lies at the center of the modern company's economic success or failure, displacing the competitive advantages of the past. Proximity to raw materials once conferred an advantage on an economy, but now can be bought and moved to wherever they are needed. Access to capital once bestowed a significant advantage, but now capital is a commodity that can be borrowed in New York, Tokyo, London or from anywhere else in the world.

Knowledge, which used to be tertiary—after raw materials and capital—in determining economic success, is now primary. With this reality comes the need for more differentiated systems of determining who owns what intellectual property, better protection for whatever is owned and

faster systems of dispute resolution when disputes arise—as they will.

Clear, easily enforceable, sellable ownership rights to intellectual property have to be established if capitalism is to work in a world where knowledge is the key to wealth. Reverse engineering (the politically correct phrase for copying) is a way of life in the corporate world. But where should the limits be? Whatever the answer, it's not to be found in a patent system more than a century old.

Everyone understands what it means to own land or productive equipment and how those rights can be enforced. It is not so clear, however, what it means to own knowledge or how those ownership rights can be enforced. Capitalists own the equipment their workforce uses, but can they own the knowledge their workforce uses? What part of their knowledge can employees take with them when they move to a new employer? How do employers stop employees from taking

BY LESTER C. THUROW

ILLUSTRATIONS BY SARAH WILKINS

decoding
the past
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the employer's intellectual property when they go? Ownership rights to land and equipment last forever. Does the ownership of knowledge last forever? If not, how long does it last? Everyone knows the difference between public lands and private lands, but where is the dividing line between knowledge in the public domain and knowledge in the private domain? Even if the line can be defined, how is it to be enforced?

Old Systems, New Problems

Designed more than a hundred years ago to meet the simpler needs of an economy based upon natural resources and mechanical devices, our system of intellectual property rights is an undifferentiated, one-size-fits-all system. Consider the real case of a physician who noticed a relationship between an elevated level of a particular human hormone and a congenital birth defect. He was awarded a patent for his observation, although by itself his test had too many false positives to be useful. But later developments showed that if his test was used along with two others, they could accurately forecast whether a baby would be born with Down's syndrome. Today the physician is suing to get a \$9 fee from every laboratory that uses his part of the test. If he wins, the cost of testing will more than double.

Should the physician who first observed how the existing gene works have some intellectual property rights? Probably. But they should not be the same kind of rights as those granted to someone who invents a new gene to replace the defective one. Noticing what an existing gene does is simply not equivalent to inventing a new gene. Biotechnology makes such distinctions necessary.

The prevailing wisdom among those who earn their living within our system of intellectual property protection is that some minor tweaking here and there will fix the problem. The prevailing wisdom is wrong. The time has come not for marginal changes but for wide-open thinking about designing a new system from the ground up. This is never going to happen if the problem is left to those who make their living operating the current system. They have too many vested interests in preserving it with the fewest possible modifications.

Without stronger systems of protection, companies will defend their economic positions by keeping their knowledge secret, but a recent study found that 73 percent of private patents were based on knowledge generated by public sources such as universities and nonprofit or government laborato-



existing knowledge. Each deserves a different kind of patent. Furthermore, new technologies are making the enforcement of property rights much tougher. People can use high-quality scanning technologies with optical character recognition to build electronic libraries quickly and cheaply. A system designed to allow people to browse through books from physical libraries cannot provide the right framework for dealing with the issues raised by the possibility of downloading a book from an electronic library.

If books can be freely downloaded, then those selling financial information will find that their databases can also be downloaded and resold by competitors whose costs are lower precisely because they did not incur the costs of creating them. Telephone book publishers try to stop this practice by inserting some phony numbers into the phone books so that they can prove in court that competitors have not independently generated their own list of names and numbers.

The future of printed materials can be seen in what is now happening in the recorded music business. Even though the equipment needed to record compact discs is too expensive to be found in every household, CD pirates may hold as much as a 20 percent share of the market. In contrast, in personal electronic publishing the equipment is as cheap and available as a personal computer plus a scanner. The fully electronic library does not yet exist, but it soon will. One is being built in

▶ Knowledge-based capitalism isn't going to work without
a new system for determining who owns
or controls intellectual property rights.

ries. Private, secretly held knowledge simply does not generate the next generation of knowledge. The exact line between what is and is not allowed is going to be difficult to draw.

Advancing Knowledge

The differentiation must start with distinctions between fundamental advances in knowledge and logical extensions of

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Singapore. The legal system may be able to stop factories from copying and selling CDs or books in volume, but it cannot stop individuals from replicating materials for themselves or selling small numbers to their friends. One has to expect that pirated works will end up with an even bigger market share of what used to be conventionally printed materials than they now have of CDs and tapes.

Knowledge-based capitalism isn't going to work without a new system for determining who owns or controls intellectual property rights. Capitalism requires clear, easy-to-enforce ownership rights.

Knowledge Pirates

When computer makers ship their products "naked"—that is, without an operating system—as they often do in Asia, the only reason they do so is to allow the use of pirated software. These computer makers have the tacit approval of local governments to violate patents and copyrights. In Thailand, up to 97 percent of the software in use has been illegally copied, and even in the United States the figure may be as high as 40 percent. Estimates of pirated software in Europe range from a high of 80 percent in Spain to a low of 25 percent in the United Kingdom.

Computer software provides a good illustration of what happens when patent and copyright laws do not keep up with technology. Judges end up making decisions that they should not be making. One such decision ruled that the "look and feel" of a software program

could not be patented—which means, effectively, that any successful program can be legally copied. The copiers need to write their own code, but they start knowing exactly what the program is supposed to do, how the internal programming components are structured, how the final program is supposed to look and feel, and that a viable market exists for the product. As a result, the copier has lower costs and faces much less market uncertainty and risk than the original writers of any successful software program. When software programs cannot be protected effectively, it is not just the Microsofts that will lose. Retailers that develop software to sell their products over the Internet will find that software copied and freely used by their competitors.

Increasingly, the acquisition of knowledge is central for both catch-up states and keep-ahead states. Smart developing countries understand that reality. Operating

as a monopsonist (a monopoly buyer) and dangling access to its domestic market as an enticement, China has demanded the sharing of technology from companies such as Boeing and Reuters that sell in its markets. It doesn't need their capital, since it saves 30 percent of its income and has accumulated \$100 billion in international exchange reserves—but it demands their knowledge in return for the right to operate in China. Americans deplore China's demands but remember fondly from their high school history classes the clever Yankee engineer with a photographic memory who visited British textile mills in the early 1800s and then reconstructed those mills in New England. Initially Americans were equally amused in the aftermath of World War II when Japanese businessmen with their cameras were ubiquitously touring U.S. factories. They are no longer amused. Few today will let Third World visitors into their plants.

The Third World Catches Up

Yet copying to catch up is the only way to catch up. Every country that has caught up has done it by copying. Third World countries know that unless they can acquire the neces-

▶ In Thailand, up to 97 percent of the software in use has been illegally copied.

sary knowledge, they will never make it into the first world. Third World countries cannot afford to buy what they need—even if those who have the knowledge are willing to sell, and they are not. They have to copy.

Doug saved on Daisy's vet bills by visiting his company's Intranet site.



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The managing partner of a large U.S. consulting firm urged his fellow consultants to recommend relocation to India because Indians were very good at copying, had few laws making copying illegal and often did not enforce the laws that did exist. He remarked that India recognized patents only on the processes for making drugs, not on the drugs themselves, but then went on to say that Indians were very good at developing alternative manufacturing processes. The fact that no one

checks those processes very closely to see that they are really different was left unsaid. Nor did he need to say that what was made in India could be slipped quietly into the channels of world commerce without anyone having to pay for knowledge that would be considered proprietary elsewhere.

While one can understand why developing countries do not want to pay royalties for using the drugs necessary to keep their citizens healthy, it is harder to make a similar case for why they should be allowed to pirate Madonna CDs. And India does just as much of the second as it does of the first.

The issues are not just those of where a country stands in the invention cycle or where it stands on the economic development ladder. Different cultures and different parts of the world look at intellectual property rights quite differently. The idea that people should be paid to be creative is a point of view that stems from the Judeo-Christian-Muslim belief in a God that created humanity in his image. It has no analogue in Hindu, Buddhist or Confucian societies. There are real differences in beliefs about what should be freely available in the public domain and what should be for sale in the private marketplace. In Asia, few pieces of ancient art have the names of their creators inscribed upon them. Knowledge is seen as a free good, since there is no concept of it having to be created by human beings using expensive processes.

Yet despite these differences in economic positions, cultures and historic practices, no system of protecting intellectual property rights can work unless most of the governments of the world agree to enforce it. A law that does not exist or is not enforced in country X is essentially a law that cannot be enforced in country Y. If one tries to enforce the law in country Y, production simply moves to country X to escape regulation.

What different countries want, need and should have in a system of intellectual property rights is very different depending on their level of economic development. National systems, such as that of the United States, are not going to evolve into de facto world standards. The economic game of catch-up is not the game of keep-ahead. Countries playing either game have the right to a world system that lets them succeed. Whatever system is built, it will have to be a global system that allows for this diversity of positions and beliefs. **END**

Lester C. Thurow is the Lemelson Professor of Management and Economics at the Massachusetts Institute of Technology's Sloan School in Cambridge, Mass.

Ride the Wave

Lester Thurow chats about the New Economy and how companies may survive in it

CIO: Is there really a New Economy, or are we in the midst of the old economy with new tools?

Thurow: An economic revolution changes how everyone does business, not just how a specific product is made. So the invention and production of the automobile, for example, is not a revolution. There were 200 or so auto manufacturer's in the 1920s, and they eventually became just three, but business was conducted the same way. The steam engine, however, revolutionized how all work was done. Similarly, industrialization revolutionized where and how all work was done. And in our time, computers, networking and the Internet are changing how all work is done. We're truly in a revolution.

What could derail the New Economy?

Social unrest can derail a revolution. Social unrest comes from inequality. This is the dark side of social change. Sooner or later, some politician taps into the unrest. It's been a great decade for knowledge workers, but it has been a bad decade for those who lack the skills of the New Economy. If you are in the top 20 percent of wage earners, you've just enjoyed the best decade in American history. If you are in the second 20 percent,

you are doing OK. But the bottom 60 percent is not doing well. In this decade, American males have suffered a real loss in salary and wages of 4 percent because the traditional means for a man to earn good wages without intellectual skills are disappearing. The number of good manufacturing jobs for men is shrinking. Only because women's wages have risen has total family income stayed the same.

So how can we prepare for drastic change?

All a person can do is get a feeling for what is happening and then ride the wave. It's like being a surfer. Survival goes to companies that ride the wave, and if they are lucky, they get to ride it for 20 years or so. That's a good run for a business. And luck counts as well. Look at all the Microsoft millionaires, people who just happened to be there at the beginning. No one can predict with accuracy the micropatterns of economic change. Suppose in 1981 God whispered in my ear that in just two decades there would be 100 million computers on peoples' desks. Even if I had that divine knowledge, I'd only have gone out and bought shares in Commodore, a company that's long bankrupt and gone.

—Perry Glasser



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The BankAmericard was a great way to keep track of your spending. It was a simple thing to use, and it was a great way to keep track of your spending.

Three decades of IT innovation have meant organizational change everywhere; developments at Visa USA and THE WALL STREET JOURNAL epitomize the trend. ♦

FORMATIVE YEARS

TALL FIREPLACES. WIDE PLANK FLOORS. Quilt-covered four-poster beds. This sleepy inn in small-town Maine looks a great deal like it did 30 years ago. In fact, beyond the addition of electric lights and indoor plumbing, the drafty

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white-clapboard mansion probably hasn't changed all that much in the past century. Except that, these days, virtually no cash changes hands here. The owners not only accept payment by plastic, they all but require it.

And although the inn is as free of radios and television sets as it was 30 or 130 years ago and gets only one copy of a local newspaper, visitors have no trouble getting their business and technology news. They just plug into the data line hidden behind a Victorian writing desk in the front parlor, connecting to Web news sites such as The Wall Street Journal Interactive Edition.

Information technology has altered two fundamentals of business in even the most quiet, remote corners: how people pay for things and how they inform themselves. Naturally, the industries serving those needs have changed dramatically over the past few

decades—and, their leaders warn, they're going to keep right on changing, faster and faster.

Among the companies that know plenty about constant, high-speed change and expansion are Visa USA Inc. and *The Wall Street Journal*. At first glance, they've got little in common: San Francisco-based Visa didn't exist 30 years ago, while *The Journal* began as a handwritten newsletter on Wall Street in 1882. Visa's product has always been virtual: commercial and personal lines of credit, enabled by little plastic cards. *The Journal* remains best known for its Industrial Age product, the ink-and-pulp newspaper delivered to about 1.8 million readers every weekday, although its four-year-old Interactive Edition continues making Information Age history as the Web's most successful paid-subscription site.

But technology continues to transform both companies. Visa, which handles 22 million transactions a day—that's 253 per second—is moving toward cards equipped with computer chips instead of magnetic strips. Such smart cards, already

BY ANNE STUART

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in limited use, eventually will be capable of handling everything from buying milk to financing a mortgage. Meanwhile, *The Journal* and its parent company balance the demands of publishing its mainstay print publication, growing its Web edition, and launching many new print and digital products, such as foreign-language editions, *The Wall Street Journal Sunday* and *dowjones.com*, a vertical portal of free business resources.

We took a day-in-the-life look at these two very wired organizations: one on the East Coast, one on the West, one old and one new, but both with international influence, both moving almost unfathomable amounts of information every minute and both transformed in ways their founders couldn't have imagined. Their evolution over the last 30 years has revolutionized how people get information and spend money, even in a timeless town in Maine.

Visa USA

"I'm getting on a plane to Zurich tomorrow with two Visa cards and \$100 in my pocket, and I won't give it another thought," says Win Derman of San Mateo, Calif., who recently retired after 26 years as a Visa executive and who, as the company's unofficial historian, is writing a book on the company. "I know I can pay my bills, I can eat, I can shop."

If Derman had been taking this trip

Visa USA Inc.

HEADQUARTERS: San Francisco

FOUNDED: 1974 (known as Visa since 1976)

REVENUES: Privately held

OWNERSHIP: Owned by 21,000 member banks; Visa USA is the largest of six regional companies lumped under the umbrella of Visa International

EMPLOYEES: approximately 5,000 worldwide

MARKET SHARE (1998): 53 percent

VOLUME (1998): \$660 billion from June 1998 to June 1999, up from \$525 billion in 1997; projected to reach \$1 trillion by 2002, including nearly \$100 billion in e-commerce by 2003

TRANSACTIONS (1998): 8 billion

AVERAGE TRANSACTION SPEED: Less than 2 seconds (1998), down from 54 seconds in 1973

CARDS (1998): 322 million credit and debit cards, accepted at 17 million locations and 300,000 ATMs globally

URL: www.visa.com

in, say, 1970, things would have been much different. Thirty years ago, "There weren't a lot of credit cards," says Carl Pascarella, president and CEO of Visa USA. "People used checks, they used cash, they used traveler's checks when they traveled," especially internationally; often, they needed to exchange currency either before leaving or upon arrival.

As Visa officials are only too happy to point out, credit cards are no longer just a convenient way for consumers to procrastinate on payment. For business people, they're all but required. "Think about trying to rent a car, check into a hotel, buy an airline ticket without a [credit] card," Pascarella says. Those little pieces of plastic give consumers "an unsecured line of credit that's good anywhere in the world."

Accordingly, it's

changed the lives of employees at Visa, the intermediary settling transactions between the merchant's bank and the cardholder's bank. In the early days, customer service representatives sat shoulder-to-shoulder in a room the size of a football field, answering call after call from merchants serving customers who wanted to charge a purchase. Merchants would read off credit card numbers—often as customers waited at the register—then wait for the customer service rep to provide a string of numbers known as an authorization code. If service reps couldn't reach the issuing bank—if, for instance, they were calling after hours or on a holiday, merchants had to either reject the sale or accept it and risk eating the loss if the card turned out to be invalid.

After approving the charge, the merchant used a hand-operated imprinter to stamp the card's identifying information onto a sales slip, usually in triplicate, peeling off one inky copy as the customer's receipt. At the end of each day, merchants separated the slips into "ours" and "theirs," keeping one hard copy of each receipt and sending the other to the credit card companies. Getting reimbursed could take weeks.



"We've taken the people and the paperwork out of the system," says retired Visa USA executive Win Derman, now the company's unofficial historian.

PHOTOGRAPH BY JASON GROW

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In some cases, merchants needed only verbal authorization for large charges—say, for more than \$50. For smaller sales, they flipped through paperback books, updated every month or so, listing column after column of stolen credit card numbers. As long as the customer's card number didn't show up, merchants could authorize the sale (which, when busy, they often did without checking the guide). Later, by the early 1980s, merchants swiped cards through devices that automatically dialed the bank, feeding back either approval or rejection. (See the timeline on Page 93.)

These days, unless there's a problem, the whole process happens automatically. "There is no paper flow to speak of anymore," Pascarella notes. There's human intervention only if something's amiss at either end. And everything happens much faster: With VisaNet, Visa's proprietary transaction-processing system, the average transaction-approval time has dropped from nearly 1 minute in 1973 to less than 2 seconds today, critical for processing the millions of credit card charges that go through daily.

Meanwhile, because major credit cards are so convenient, consumers increasingly use them for goods or services that they used to buy with cash or checks, such as groceries, doctor's visits and prescription drugs. In some cases, they even charge items that once would have required bank loans, such as small businesses that finance their launches or furnish their offices by charging everything. Just as consumers overcame concerns about giving credit card numbers to catalog merchants by phone, they are moving past their fears about using their accounts on the Internet. And

they're increasingly using another form of payment: Visa check cards, which deduct funds directly from cardholders' checking accounts rather than apply them to a credit account.

Apparently, customers want to use Visa cards "for everything from a milkshake to a Mercedes," as Harvey J. Bondar, Visa's executive vice president of strategic marketing, puts it. In 1998, Visa enabled more than \$600 bil-

lion in sales. That translates to more than 8 billion credit, debit and commercial card transactions—an average of more than 15,000 every minute, or about 253 per second.

That's a lot of activity. Not surprisingly, Visa claims to have the world's largest transaction-processing system, capable of handling more than 10 times as many transactions in the same amount of time during peak periods, such as the week before Christmas. Visa CIO Scott Thompson says he built that idea of constant rapid access into every aspect of the company's technology. "I translated 'everywhere you want to be' into the [VisaNet] system," he says. "We have zero tolerance—truly zero tolerance—for downtime."

To make sure its transactions keep moving, Visa maintains a data center built on a 10-foot-thick foundation of reinforced concrete anchored in bedrock, with redundant backup power, cooling and systems. Built to withstand a disaster on the magnitude of the 1906 San Francisco earthquake, the data center is so solid that when another quake rocked the Bay Area in 1989, some data center employees didn't realize it had happened.

Inside, room after room filled with row after row of quietly humming servers provide no outward sign that hundreds of millions of dollars of digital expenditures pass through here every day. While the center still relies on some IBM mainframe computers, they're both more compact and more powerful than their predecessors. One unit, about the size of two large refrigerators, replaced a machine 10 times its size—and provides at least twice the



Visa CIO Scott Thompson has to build systems to accommodate 253 transactions per second—or more.



Carl Pasarella, president and CEO of Visa USA, carries on the legacy of innovation begun by Visa USA's first president, Dee Hock, in 1976 (top).

1958 Visa USA Inc. (Visa International)

1958 Bank of America issues 60,000 BankAmericards in California.

1970 U.S. banks form National BankAmericard association.

1974 Bank of America licenses charter Ibanco, an international banking company, to issue **BankAmericard** outside the United States. Company establishes first electronic clearing and settlement system.

1976 Ibanco becomes Visa International; National BankAmericard becomes Visa USA under new bank partnership model.

1979 Begins using electronic-dial terminals at point of sale.

1983 Launches global **automatic teller machine** network.

1984 Launches computer-based system to pinpoint suspicious credit-card transactions.

1986 Begins using multiple-currency clearing and settlement system.

1987 Launches China's first computer card-transaction processing network.

1988 Issues first bank cards in **Russia**.

1993 Launches neural network to combat fraud, establishes international pre-paid card, offers first **"smart card"** with

merchant loyalty, offers first corporate, business, purchasing cards.

1995 Introduces cards with computer chips.

1997 Successfully makes first secure **electronic transactions**.

1998 Releases first multi-application smart card based on open standards.

1999 Completes first download of electronic cash via **mobile phone**;

develops card with built-in magnifying glass for reading small print.

2000 Moves forward with eVisa, the company's **e-commerce** initiative.



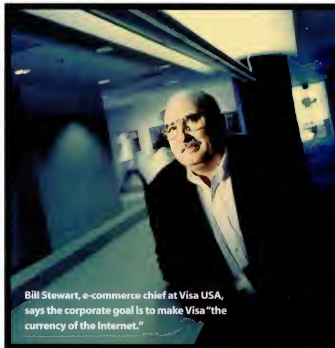
known brands, Visa keeps an exceptionally low profile in the real world. Business cards and promotional materials include only a San Francisco post office box. For security reasons, the company's headquarters in nearby Foster City feature absolutely no exterior signage, just a street address. The first sign alerting visitors that they've reached the right building is in the parking garage, where trash cans feature that familiar blue-and-gold logo. Security is equally tight at the unmarked data center a few miles to the north: Lower-level staffers have access only to their own departments, and even senior employees need to pass through airlocks to move from one part of the center to another.

Today, Visa continues to expand to new markets. Among its top priorities: teenagers, who often get credit cards with their parents' approval. "They have an intense amount of capital," Bondar

capacity. The entire VisaNet system processes an average of 100,000 transactions per minute for more than 12 million merchants and 19,000 member institutions worldwide. Relying on fiber optics, satellite and 9 million miles of communications lines, the system includes backup centers in Denver, McLean, Va., Yokohama, Japan, and Basingstoke, England.

Visa's image has changed dramatically during its history, but particularly in the past decade. In the mid-to late-1980s, consumers viewed Visa and MasterCard as interchangeable. "At the time, they were like Chevrolet and Chevrolet," says Elizabeth J. Silver, Visa's senior vice president of advertising and brand management. Businesses tended to view Visa as second in prestige to American Express because the brand stood for more prosaic consumer activities. "It was the card women used when they went to the mall to buy shoes for the kids," Silver says. Over the past decade, Visa worked not only to distinguish itself from MasterCard but to compete aggressively with American Express Co. The Visa strategy: emphasize access, acceptance and universal admission to all the desirable places where even an AmEx gold card wouldn't buy you a cup of coffee.

Curiously, for a company boasting that it's now got one of the world's best-



Bill Stewart, e-commerce chief at Visa USA, says the corporate goal is to make Visa "the currency of the Internet."

says. "We want to make sure we embrace all their needs." After all, the CD and skateboard buyers of today are the opera ticket, sports car and home-mortgage consumers of tomorrow.



$$N_0 \leq N_2 \left(\frac{s + \log N - 2}{s - 1} \right)!$$
$$N^2 \left(\frac{s + \log N - 2}{s - 1} \right) C^{5 + 1}$$
$$N^2 2^{6 + \log N - 2} C^{5 + 1}$$
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The company also continues to build its traffic in debit cards, which subtract money directly from checking accounts. Pascarella expects those cards to eliminate paper checks over time.

The company has already begun testing smart cards that contain microprocessor chips with 90 times more memory than magnetic strips. Smart cards not only will let consumers access their credit checking accounts but will track loyalty programs and store electronic cash, passwords and identification numbers.

Because credit card transactions have long been electronic, Visa already knows something about e-commerce. But the Internet's growth has spawned a whole new set of competitors. They include telecommunications companies, already experienced at handling micropayments such as 35-cent telephone calls, and Microsoft Corp. and Yahoo Inc., which are experimenting with electronic wallets. Then there are newcomers like eBay Inc., where buyers mail checks directly to sellers without going through a transaction-settling intermediary like Visa. Visa predicts that by 2002, two out of every three Visa cardholders will shop on the Internet; by the following year, Internet e-commerce will account for at least 10 percent of the company's volume.

Pascarella compares his company's e-commerce challenge to the 1997 Belmont Stakes (which was, of course, sponsored by Visa), when a horse named Touch Gold unexpectedly sailed past leader Freehouse to win the race. "It's the nontraditional competitors you've got to worry about," he says.



"We've got to keep reinventing ourselves [to stay ahead]."

For Bill Stewart, Visa's e-commerce chief, the future depends on making Visa cards—or account numbers, if plastic cards eventually disappear—the most desirable way to pay for anything online. The corporate goal, he says, is "to make Visa the currency of the Internet."



Assistant Managing Editor Paul Martin Sr. says round-the-clock news coverage is the biggest change in his 39 years at *The Wall Street Journal*, the publication founded by Charles Dow (top) and Edward Jones (middle).

The Wall Street Journal

It's mid-morning on an autumn weekday in New York City, with cabs and limousines and pedestrians jamming the streets and sidewalks around the World Trade Center at the very tip of Manhattan. But up on the ninth floor of 200 Liberty St., the main *Wall Street Journal* newsroom is largely deserted, row after row of blinking PC monitors facing row after row of empty chairs. Later in the day, as reporters and editors arrive for their shifts, the desks and cubicles and offices will fill with frantic, furiously typing journalists. For now, though, it's quiet, almost hushed, except for the section housing the newspaper's Web site, known as The Wall Street

Journal Interactive Edition. As they do around the clock, Interactive Edition staffers are busy refreshing the Web site with the latest business news from around the world. At this hour, the updates are mostly from Asia and Europe; as the day wears on, new stories will come from Latin America, the United States and Canada.

That 24-hour approach to news is the biggest change Assistant Managing Editor Paul Martin Sr. has seen in his tenure at the 110-year-old business newspaper, which, with about 1.8 million readers, remains neck and neck with *USA Today* for the title of the United States' largest national newspaper.

Of course, at its foundation, *The Journal* remains the flagship publication for Dow Jones & Co. It still covers Wall Street and the rest of the financial world. It still publishes its text-heavy black-and-white print newspaper every weekday. It still hires what its management believes are some of the world's best journalists (an effort that has undoubtedly contributed to *The Journal's* 21 Pulitzer Prizes).

But *The Journal* is a very different publication and a very different

place to work than it was when Martin came on board as a copy editor 39 years ago, or even when fellow editors Rich Jaroslovsky and Cathy Panagoulas joined the staff in the mid-1970s.

Before the mid-'80s, *The Journal* enjoyed a near monopoly on daily business news, a dominance dating back to 1882, when its founders circulated handwritten updates on New York Stock Exchange activity. (See the timeline on Page 100.) *The Journal's* historic target audience: middle management, primarily in the United States. Its size: one section, 32 to 36 pages. "That was all the businessman had time to read; it was his second paper," usually a supplement to a general interest pub-

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– Bob Leshner and Charlie Bise, Information Technology, Exel Logistics

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lication like *The New York Times*, Martin explains. And, for much of its life, *The Journal* was distinctly American. For many years, the newspaper's foreign staff consisted of one reporter, a London-based correspondent who covered stories everywhere from Iceland to Istanbul.

That's all changed. Today, *Journal* editors reach out to a much broader audience, including small businesses, startups and Internet-based companies. "We're no longer writing for just the big corporate guys," says Panagoulas, who began as a proofreader in 1976 and is now national news editor. And because it is no longer aimed at an Industrial Age audience, *The Journal* no longer runs graphics with arcane figures such as the number of cardboard boxes manufactured nationally or the amount of coal loaded in Norfolk, Va. "These things are no longer [significant] indicators in the new economy," Panagoulas says.

The paper publishes about 80 pages daily in multiple sections. And it staffs 11 domestic and more than 36 overseas bureaus, produces separate Asian and European editions, and provides business stories in Spanish and Portuguese for Latin American newspapers.

The production processes have grown, and changed, as well. The print newspaper is, of course, still printed on presses and delivered by trucks. But these days, stories and graphics are transmitted by e-mail, satellite or over an internal network to printing plants in 17 locations nationwide and about a dozen others internationally, allowing the paper to provide more news with later deadlines.

Obviously, journalism technology has evolved rapidly in recent years too. Reporters used to dial telephones connected to a switchboard; at one point, making a call meant requesting an oper-

ator to get an outside line. (Voice mail, one editor recalls, meant the voice of an intern or colleague answering your phone if you were away, taking a handwritten message.) Before the advent of CNN in the early 1980s, there were no newsroom televisions; only a few editors kept small sets in their offices. But with 24-hour financial news available around the world, editors realize they need to keep a constant eye and ear on the other media. They religiously monitor upstarts like CNBC, CNNfn, CNET, TheStreet.com, Bloomberg News and *USA Today*, among others, looking for any business scoops their reporters might somehow have missed.

And, of course, before the mid-to-late-1970s, reporters worked on typewriters, first manual, then electric. They pasted the typed pages into a single long sheet, rolled it up like a paper towel tube and dropped it on a conveyor belt that carried it around the newsroom until it reached the right editor, who then edited with pencil and sent it on to be typeset. Wire machines, isolated in their own room, spit out streams of cheap paper containing stories from The Associated Press, Reuters Group PLC



Technological changes give *Journal* writers and editors like Deputy Managing Editor Barney Calame more latitude on last-minute stories than Dow Jones cofounder Charles Bergstresser (inset) could ever have imagined.

and other news services. Distant correspondents sent stories by telex or early versions of fax machines or by dictating them over the telephone—each procedure requiring somebody else to retype the words.

Journal veterans universally recall a much noisier environment in those days, and not just because of all those telephones and typewriters. "We used to communicate back and forth by yelling at each other—the desk yelling at you, 'Hey, when are you going to have that next take [story page]?' " recalls Deputy Managing Editor Barney Calame, who started

working for *The Journal* in the 1960s. "Today, things are so quiet, even here at our big copy desk in New York, because everybody is e-mailing or using the internal message system" to ask the same questions.

Researching a story inevitably meant searching through small folders filled with folded-up newspaper stories painstakingly clipped from each day's paper and filed by subject. *The Journal's* research library also included shelf after shelf of newspaper-sized black books containing bound copies of *The Journal* and *The New York Times*. Looking up past stories was something like using a dated encyclopedia; reporters turned to an index, then flipped to the indicated page. Of course, that system worked well only for stories with a history, and only if that history had been previously chronicled in either newspaper. For instance, if someone were covering a little-known nominee for a Labor Department post, Calame says, "We often had no way of really knowing whether the guy had been involved in stock fraud in Omaha or [had] once been Man of the Year in Los Angeles."

When *The Journal* began to consider computerizing its newsroom in the late

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1970s, Calame, who was bureau chief in Los Angeles, begged to have L.A. be one of two offices testing the new system, which consisted of dumb terminals connected to a mainframe in New York City. Not long after, he got to borrow a portable computer from Dow Jones News/Retrieval salespeople, a bulky box that took several minutes to transmit even a short story, word by painstaking word.

Now everything happens electronically (including constantly updated information flowing into the famous Dow Jones stock "ticker," which records the information only digitally, no longer producing the long streams of hole-punched paper used in ticker tape parades). Reporters can search the archives of *The Journal* or just about any other newspaper through their database-searching tools such as Factiva. (Previously known as Dow Jones Reuters Business Interactive, the information service—also available publicly by subscription—provides access to thousands of stories from Dow Jones, Reuters and other publications.)

The newsroom's few remaining typewriters gather dust along one wall, used only as historical exhibits for newsroom tours. Stories move from reporter to editor to copy editor, always electronically, materializing in the physical world only

The Wall Street Journal (Dow Jones & Co.)

1882 Charles Dow, Edward Jones and Charles Bergstresser

founded Dow Jones & Co. near New York Stock Exchange, publishing handwritten stock-report newsletters.

1889 Company begins publishing *The Wall Street Journal*; first four-page edition sells for 2 cents.

1896 Company launches Dow Jones Industrial Average to track stock market.

1920 WSJ circulation reaches 20,000.

1929 Company launches Pacific Coast edition days before stock market crash plunges nation into depression.

the newspaper will switch to pagination, meaning editors will assemble entire pages on their desktops rather than sending them electronically, piece by piece, to composing rooms in Orlando, Fla., and Chicopee, Mass. Doing that will let the print edition push its deadlines further back (currently 7 p.m. for the first edition, 10 p.m. for the second), at least for some coverage. "It will give us a way, on some really important stories, to get in the last bit of interpretation and analysis from an interview that we just got late in the day," says Calame. And it will give editors more control over how

1960s WSJ circulation surpasses 1 million.

1976 *The Asian Wall Street Journal*

launches in Hong Kong (circulation now 62,000).

1980 WSJ begins publishing in two sections.

1983 *The Wall Street Journal Europe* launches in Brussels (circulation now 71,000).

1988 WSJ begins publishing in three sections.

1991 *Monthly Wall Street Journal Classroom Edition* launches (circulation now 125,000).

1992 *SmartMoney:*

The Wall Street Journal Magazine of Personal Business launches (circulation now 725,000).

1994 *The Wall Street Journal Special Editions* launch, offering local-language reports in 28 countries (circulation 4 million, primarily in Spanish and Portuguese).

1996 *The Wall Street Journal Interactive Edition* launches.

1997 WSJ establishes business TV alliance with **NBC**.

1998 WSJ launches print *Weekend Journal*.

1999 WSJ launches *The Wall Street Journal Sunday* and Dow Jones launches *dowjones.com*, a vertical portal of free business resources.

2000 Parent company Dow Jones

& Co. and **Reuters Group PLC**

expect to launch combined Web-based news and research tool called *Factiva*.

◆ "We used to communicate back and forth by yelling at each other"

—Barney Calame, Deputy Managing Editor

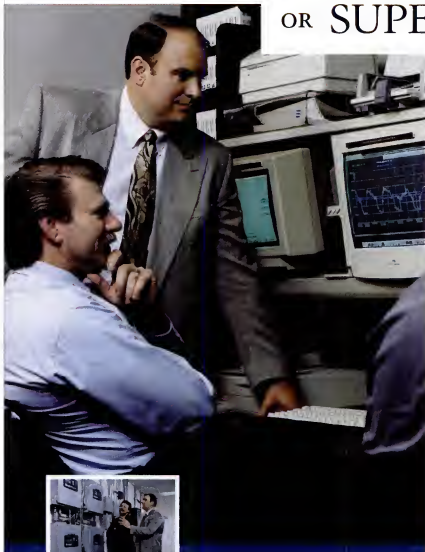
when they're translated to ink and paper at one of *The Journal's* printing plants, which, like the rest of the publishing world, switched in the 1970s from "hot" to "cold" type—that is, from metal Linotype impressions to photographic reproduction.

In fact, *The Journal's* next biggest technological challenge will probably be cutting another major step from its production process. Sometime in 2000,

stories appear on the page, a decision now made in those distant composing rooms. "We might gain some time, or at least the ability to make changes," say Panagoulas. Says Martin: "We'll no longer be at the mercy of the production process."

Meanwhile, *The Journal's* biggest technology venture remains its groundbreaking Interactive Edition. Launched in 1996, the news- and resource-rich site

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remains the Web's most successful subscription-based service (\$29 a year for print *Journal* subscribers and \$59 for everyone else), with more than 300,000 subscribers.

Like other new media, the Interactive Edition has created a whole new set of how-do-we-handle-this questions for its parent publication. For instance, should the Interactive Edition be first to break big stories, possibly alerting competitors to scoops? Or should it hold off until print deadlines have passed so that nobody else can match the story on the same day?

So far, it's opted for the latter, often releasing big global stories in the wee hours of the morning, long after print editions have gone to press. For instance, on this particular weekday morning, the Interactive Edition released a report at 5 a.m. Eastern Standard Time about a Federal Express board meeting in Paris—long after the print *Journal* and all of its newspaper competitors had been published (without the story).

The Interactive Edition faces plenty of challenges in the next few years. Chief among them: figuring out ways to provide electronic news through a variety of media, such as cell phones, pagers and personal digital assistants. "The luxury of having one device to aim at—a computer—and one level of access is gone," says Interactive Edition Editor Neil Budde.

Yet, online and off, some traditions endure at *The Wall Street Journal*. Among them are the newspaper's distinctive dot-and-dash drawings, used instead of head-and-shoulder mug



The Journal's groundbreaking Interactive Edition raises new policy questions all the time for Managing Editor Rich Jaroslovsky (left) and Editor Neil Budde.

shots. Despite their 19th-century feel, the drawings date back only to about 1978. And although they're equipped with Macintosh computers to create charts, maps and graphs, the newspaper's artists still create those pictures entirely by hand from photographs, using a step-by-step drawing process that takes three to five hours per picture. The reasoning: It creates a sense of continuity, of tradition, of recognizing that, in some ways, quality just

can't be improved by technology. As Jaroslovsky, now managing editor of the Interactive Edition puts it, old venture or new, online or off, it's all still *The Wall Street Journal*. And that powerful brand name "has to stand for something; it has to stand for the same thing across all these media," Jaroslovsky says. He recalls his first day on the job, as a college intern in 1974, when he went to lunch with a senior editor. "He told me about a mistake he had made as a reporter and the huge reverberations from it. The message I took away from that was that accuracy matters above all, and that the credibility of *The Wall Street Journal* rests on [individual employees]." Despite all the technological changes, Jaroslovsky asserts, "Every word of that is still true." **END**

Anne Stuart is a former senior editor at CIO.

The Wall Street Journal

(Dow Jones & Co.)

BASED: New York City

FOUNDED: 1889 (newspaper); 1882 (parent company)

REVENUES (1998): \$2.15 billion (Dow Jones & Co.)

CIRCULATION: Nearly 1.8 million print readers; more than 300,000 paid Interactive Edition subscribers

EMPLOYEES: 2,000, including 200 on Interactive Edition, in nearly 50 news bureaus and 30 printing plants worldwide

HONORS: 21 Pulitzer Prizes to date

URL: wsj.com



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A stylized, graphic illustration of a jazz band. In the upper left, two men in white suits play yellow trumpets against a blue, cloud-like background with musical notes and a sharp sign. In the lower right, a man in a white suit and bow tie plays a piano. A large, golden-yellow saxophone is positioned in the center, with a bright sunburst effect behind its bell. A large, dark blue double bass is also visible. The overall style is modern and abstract, using bold colors and simplified shapes.

MAKING

Culture change, not technology, is key to collaboration ♦

BEAUTIFUL MUSIC

CIO TONY AVETA IS RACING TO BEAT time. His company, PSINet Inc. of Reston, Va., is in a hurry to become the world's largest provider of corporate Internet services. In each of the past three years, the 10-year-old company has doubled revenues, half through acquisition. Said revenues are approaching \$500 million—two-thirds of which is generated outside the United States. It has 73,000

business customers and a foothold in the world's 22 largest telecom markets. But if Aveta doesn't scramble, he'll be eating the dust of bigger competitors like MCI WorldCom Inc. and Qwest Communications International Inc. "We need infrastructure and assets spanning the globe," he says.

Aveta faces a double challenge: He must support the global strategy without breaking the bank. His capital assets are everywhere. SWAT teams

around the world look for new acquisitions and must work with the home office. Technical people worldwide work in virtual teams to take advantage of the 24-hour clock. If that isn't enough, the competitive and technological landscape is constantly changing. "Three months

is a lifetime," Aveta says. As a result of these dynamics, he confesses, "I am driven toward finding collaborative technologies." E-mail, chat, white boards, videoconferencing, PC conferencing, video streaming—he's tried them all.

Welcome to the 21st century, the Age of Collaboration. Aveta arrived ahead of most; others better arrive soon or they might not get there at all. Economic, social, cultural and technological forces are driving all companies toward greater collaboration among employees and with customers, suppliers and partners. For that, they need collaboration technologies, which help people work in pairs, in teams, or entire communities in real-time or on a schedule that suits each user.

Why collaborate? The age of the lonely corporate hero is over—experts estimate the typical manager spends four-fifths of the day communicating

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- ♦ Why collaboration is key to business success in the 21st century
- ♦ What hurdles keep companies from collaborating better than they do
- ♦ How a few companies are successfully using collaboration products

decoding
the past
inventing the
FUTURE

BY BILL ROBERTS

ILLUSTRATIONS BY MARTI SHOHEIT

How Do You Measure Up?

Before an enterprise embarks on any crash course in collaboration, it helps to get a sense of the potential for success

David Coleman, managing director of Collaborative Strategies LLC, a San Francisco-based consulting firm focused on collaborative strategies and knowledge management, performs an in-depth collaborative benchmark for clients. One element is the TCEP Scale, based on Coleman's formula:

$$\text{Technology} + (2 \times \text{Culture}) + (3 \times \text{Economics}) + (4 \times \text{Politics}) \\ = \text{Potential for Collaborative Success}$$

The further to the right a factor is in this equation, the greater its impact on potential success in collaboration, Coleman says. Although it is only one piece of his in-depth benchmark, companies can use the formula to take a snapshot of their potential for success with collaborative technologies and knowledge management.

Rate your company 1 to 10 based on each factor. Be as honest as you can, and use the following scale.

Technology	1 = Hard to find a computer in the enterprise. 10 = Employees can't live without e-mail, cell phones and other devices; TI line to every desktop; high usage of Internet and intranet.
Culture X 2 =	1 = Employees are asked to do their jobs, keep their heads down and their noses to the grindstone, and not pay attention to anyone else. The boss solves all problems and mandates actions. 10 = People routinely talk about important issues, much like a functional family around the dinner table; they work together as a team to solve problems.
Economics X 3 =	1 = Collaboration will make no big economic difference to the enterprise nor will it effect the bottom line. 10 = With competitors, customers and partners becoming collaborative, the enterprise is dead if it doesn't, and it has a big effect on the bottom line.
Politics X 4 =	1 = Talk about collaboration but don't do anything about it. 10 = Reaction of management: "We need it, we support and we will set the example by modeling collaborative behavior and using the tools."

Plug each factor's score into the box and multiply by its weight for a subtotal. Then add them up for a total. Scores below 60 are poor; 61 to 80 are fair. Scores above 80 are good and indicate a greater likelihood of collaborative success, or the possibility that your organization is already using collaborative tools successfully.

with others. Tasks are so complex and product cycles are so short that no one can do everything on their own. Workforces are geographically dispersed. And computers have improved personal productivity about as much as they can, which means technology's next great contribution will come from helping people work together. The Internet, unlike earlier technologies, actually makes collaboration affordable. "The environment is right for collaboration if you can find technologies that add value to the way people do business," says Aveta.

Share and Share Alike

COMPANIES ARE ADOPTING MORE collaborative technologies than ever, but they don't take full advantage of them, market analysts say. Ian Campbell, vice president of collaborative applications at International Data Corp. in Framingham, Mass. (a sister company to CIO Communications Inc.), notes that companies install Lotus Notes, Microsoft Exchange and other groupware products as they evolve beyond e-mail, the most basic collaboration tool on a computer. "But they struggle with what to do with them," he says. "They need to change the working habits of the employees. They need to foster the sharing environment."

Before an organization can put those tools to use, it must first deal with the people issues. Culture comes first, technology comes second. Reverse them and you're in trouble. "Trust, teams and technology in that order," says Carol Anne Ogdin, founder of Deep Woods Technology Inc., a Santa Clara, Calif.-based consulting firm that focuses on the human aspects of collaborative technologies. During the 10 years that she has worked with clients, Ogdin has seen many companies throw technology at what were people problems. "IT people have a touching faith in technology but don't understand what managers do or how people work." She does, however, see a few signs of change.

An example is Steven T. Miller, manager of collaborative computing at DuPont Co. in Wilmington, Del., one of Ogdin's clients. "My job isn't to roll out Lotus Notes," says Miller, who in fact is rolling out Notes. "My job is to put in place an infrastructure upon which

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DuPont can transform itself from a petrochemical company to a biotech company." Miller knows that Notes won't solve anything if the company doesn't encourage people to share. (More about DuPont later.)

Unless you attend 12-step meetings, chances are pretty good that the last time anyone genuinely expected you to share was in kindergarten. "Trust is the big issue," says David Coleman, managing director of Collaborative Strategies LLC, a San Francisco-based consulting company. "You're not going to share with someone you don't trust." U.S. companies have a long way to go, he adds. "We're a cowboy culture. You strap on the guns and go fix it. We are not a culture of collaboration."

Companies must motivate people to share. Most corporate compensation schemes, however, reward individual superstars. Coleman says smart companies—such as Cisco Systems Inc., Hewlett-Packard Co. and others—are changing bonus plans and performance ratings to reward team achievements. It's no surprise Cisco has become the poster child for collaboration among employees and with customers and suppliers. Coleman advises: "You either collaborate or die."

A company like PSINet has an advantage over more established companies. It is young, full of ideas and not yet set in its corporate ways. Its business is the Internet, which makes it predisposed to adopt Web-based collaboration technologies. With its flurry of activity around the globe, teamwork is the only way to survive. The young, techie employees have scant trouble adopting collaboration technologies. E-mail, for example, is so popular that one of Aveta's big challenges is dealing with the

volume. Human resistance is the least of his problems.

Others should be so lucky. In the following vignettes, you'll meet some companies that are trying to collaborate better with customers, among employees and with business partners. Their stories illustrate the recurring theme one hears from experts: Collaboration is not about technology; it's about culture and training.

Collaborating with Consumers

THERE'S A HIGHER POTENTIAL FOR success when the new collaborative technology grows out of an existing culture. Lands' End Inc., the catalog retailer based in Dodgeville, Wis., launched two applications last year to help customers on its Web site. One of them, Lands' End Live, takes advantage of the hundreds of highly trained customer service

representatives who know the products, the Web site and understand customers, says Jeremy Hauser, a research and development analyst for electronic commerce at the company.

Lands' End Live allows site visitors to ask for personal help over the Web from a customer service representative. The other application, Shop With a Friend, allows two people to shop together on the site. Both use technology from WebLine Communications Corp., a Burlington, Mass., developer recently acquired by Cisco. WebLine built Shop With a Friend for Lands' End, which had exclusive use of the application through the end of 1999.

The two applications work in a simi-

lar way. The technology synchronizes the browsers so that two users can navigate the site together, pointing to products of interest. The two parties can talk on the telephone while they do this or they can use a chat application. For example, Shop With a Friend lets two sisters in different states shop together for their parents.

When the company launched Lands' End Live, Hauser figured most people would use the telephone because the shopper can request a call back from a customer representative at no cost. Instead, four of five Lands' End Live users prefer chat. The company has not tracked usage for Shop With a Friend, but Hauser guesses chat is more popular there too. He says several thousand customers use the applications.

David Marshak, an analyst at the Patricia Seybold Group in Boston, expects to see more chat-based tools like the Lands' End applications. He says



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tools for team brainstorming and problem solving must be simple and usable in real-time. Hauser expects to see more retailers adopt chat, and he offers a caveat for those without a customer service culture: "We had the people; they are trained; and helping customers is what they like to do. Making the move to online collaboration wasn't that difficult to do."

Collaborating with Suppliers

SOMETIMES THE HURDLE ISN'T THE end user or the CEO but managers and executives with a vested interest in the status quo. Adaptec Inc., a Milpitas, Calif.-based maker of SCSI boards and other data transfer hardware and software, wanted better collaboration with its suppliers. The goal was to create a virtual factory that would let Adaptec, its semiconductor foundry and other supplier-partners reduce the time it took to make the custom integrated circuits, which Adaptec designs for its products.

Adaptec and its partners, including Taiwan Semiconductor Manufacturing Co. Ltd. (TSMC), adopted software from Redwood Shores, Calif.-based Extricity Software Inc. It allows partners to create and manage shared business processes over the Internet no matter what the system, file format or business rules, with little or no customization of either system.

As one result, Adaptec engineers can monitor chip wafer fabrication for quality control while the foundry in Taiwan ramps up to full volume production. If problems are detected, Adaptec engineers can make changes to the recipes from their Milpitas office.

Engineers, who had much to gain from the new processes,

accepted the change eagerly, says Dolores Marciel, Adaptec's vice president of worldwide materials. The problem was getting their partners to agree to share their information. "Three of them compete with each other for our business," she says. "There was a lot of resistance."

One reason for the trepidation is that the partners would need to go inside each other's firewalls. "Most CIOs say, 'That's not going to happen,'" says Marciel. Her own CIO was no exception; he came around when he saw that the EDI solution he preferred would be too expensive. Marciel identified the key stakeholders at each enterprise, including her own, then caressed, coerced and cajoled people into cooperating. "It is easy to sell something like this at the CEO level, and the engineers were delighted with it. It's everyone in between that makes it easy or difficult."

Hau Lee, a professor at the Stanford University

School of Business and an expert in supply chain management, agrees. "Most problems come from organizational nervousness," he says. "Information is an asset, and partners are reluctant to share an asset." He urges companies to use measuring devices to show their partners how collaboration is affecting the supply chain.

Adaptec took that advice to heart. It used to take 105 days from the time it cut a purchase order until the TSMC-made chips were assembled on finished circuit boards. Marciel says the goal of collaborating was to cut the time to 55 days. Once they achieved it, everyone involved could see how collaborating could benefit them. TSMC even decided halfway through the project to use the software with many of its other customers.

Collaborating for Transformation

COLLABORATIVE TECHNOLOGY can support the transformation of a large, global company, but it takes patience, a plan and top people who support the effort. DuPont is undergoing many important changes. For one thing, it is more global than ever, with several new plants in Asia and Europe. It sold off its petroleum company to focus more on biotechnology, pharmaceutical, feed and food industries.

The company wants to give its 20 strategic business units more autonomy and to create teams across geography and business units to pursue new business. It decided in late 1997 to roll out Lotus Notes because it needed to upgrade and standardize on a single e-mail platform (down from eight packages). It also chose Notes over other e-mail packages, Miller says, because of its out-of-the-box collaboration features, including





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Companies that collaborate better will more quickly deliver more innovative products and services.

document and discussion databases.

Thousands of companies have installed Notes. What's different about DuPont is that Miller and his team of seven people understand the problem is not technology. Like most other companies, consultant Ogden says, DuPont is stumbling along the way. But unlike most others, it understands the root of the problem is simply people and how they work.

DuPont has installed Notes in 56,000 of 90,000 desktops worldwide and expects to be done by the end of 2002. E-mail has been ingrained in the culture since the mid-1980s, Miller says. As the company enters the new decade, the goal is to give people new collaboration tools. DuPont already has 4,000 Notes document and discussion databases in use, and Miller expects to see 10,000 to 15,000 when the rollout is completed.

Acceptance of Notes was not a simple matter, however. Miller and his team had to deal with workers who wanted e-mail only and saw no value in discussion databases. But when Ogden explained that DuPont needed a marketing expert to work on motivating people to make full use of Notes, Miller hired one. "Miller got assigned the task of rolling out Notes, but he took it as a charter to solve the real problem" of sparking collaboration, Ogden says. "We had to put in place an internal marketing effort to show people the value of them," he says. They identified early adopters of Notes databases and worked closely with them to understand the technological and sociological issues around using a database.

As the early adopters began to show results, Miller's team covered the DuPont universe with presentations, phone calls and conferences about the results. "By the end of 1998, we had plenty of success stories to tell," he recalls. His team also recruited a network of 70 IT people around the globe responsible for installing Notes and used them to carry the message about the value of databases. This network has also provided valuable feedback to

Miller about problems and issues around Notes.

One such issue: personal accountability to the database, meaning the obligation to look at new material and respond. With the help of early adopters, Miller and crew developed guidelines for moderating databases and for the user's obligation to look at them and respond. They came up with consistent code words—like urgent, not urgent and FYI—to help users know the level of importance of postings.

Miller does not have his own training budget per se; training is handled by business units. Some are more committed to training people in the full use of Notes than others, and often it takes some kind of crisis to make a business unit leader realize his people need Notes training, Miller observes. Missed project deadlines and faulty communications are among the motivating factors for the handful of business units that decided to engage in Notes training, he says.

Ogden says culture change like DuPont's rarely comes from the top. Managers in the middle, who need to get things done more effectively, have the real power to move a corporation into a more collaborative culture. "Almost all guys who are willing to make changes are line of business managers who have problems to solve," she argues.

That fits Miller's experience. All top DuPont executives use Notes for e-mail, but they aren't using discussion databases, he says. He says the general managers at each business unit, on the other hand, are beginning to use the databases. As those people move into senior ranks, he expects they'll bring their database behavior with them. "One vice president and general manager was promoted, and he took it all with him," Miller says.

Collaborate or Die

AT THE VERY LEAST, LANDS' END, Adaptec, TSMC and DuPont deserve an "A" for effort. Companies that don't learn how to collaborate will be the first casualties of the new century. "Collab-

oration provides the kind of real-time agility that translates into more satisfied, loyal and buying customers," says James Canton, president of the Institute for Global Futures, a San Francisco high-tech think tank that advises Global 2000 companies. "With the Internet we now have a host of collaboration technologies that will become business critical and will create competitive advantage." The Internet, he points out, spawned products ranging from discussion threads to virtual conference rooms to virtual auditoriums, and forced the developers of client/server based products to adapt their wares to the Web.

Companies that collaborate better will more quickly deliver more innovative products and services, argues Canton, who wrote *Technofutures: How Leading-Edge Technology Will Transform Business into the 21st Century* (Hay House, 1999), a book which explores how technology will transform business in the 21st century. They'll become more efficient in manufacturing. And they will have happier, more loyal customers. Companies that don't adapt risk getting left behind. Corporate America's experience with the Web in the past five years is just a hint of things to come, he says. The Web is a standards-based ubiquitous tool that supports real-time communication. Companies that recognized this early are already reaping benefits from greater collaboration among employees and with customers, suppliers and partners.

A lot of companies don't get it, Canton says. He estimates one-quarter of the Fortune 1000 haven't even decided whether to launch an intranet. "CIOs do not realize the business critical value of collaboration," he says. The problem isn't technology, he adds. "The problem is training employees in the use of collaboration as a high performance tool." **CIO**

Bill Roberts, a Los Altos, Calif.-based freelance writer, covers business, technology and management issues. He can be reached at brobert1@ix.netcom.com.

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It's anyone's guess what corporations will look like in three decades, but one thing is clear: Information assets and how they are managed will be the foundation. Four IT pundits speculate about what the future holds for the working world. ♦

WORK IN PROGRESS

WORK HAS CHANGED SO MUCH over the past few decades, we can't help but speculate that working 30 years from now might be like an episode from *The Jetsons*. In reality, though, it's highly unlikely we'll be commuting to the office in oxygen-equipped power suits (thank

heaven). Romantic predictions that everyone will be working from the comfort of their own living room or deck may not even come true by then. Still, there's no doubt that there will be unfathomable changes enabled by advances in telecommunications, multimedia technology, ubiquitous computing and the information economy.

There will be companies providing virtual experiences (a midnight visit to Sri Lanka from a computer screen on your bedroom wall), while others will make money manipulating and selling huge directories of data. Future organizations will create new services we can't even begin to imagine now (10 years ago, who would have thought we'd go back to having our milk delivered, by something called an Internet grocer?).

CIO recently invited several promi-

nent IT leaders to discuss the workplace of the future. Along with Senior Writer Polly Schneider, the participants were: **Anita Borg**, researcher at Xerox PARC in Palo Alto, Calif., and president and founding director of the Institute for Women in Technology; **Paul Horn**, senior vice president and director of IBM Research in Yorktown Heights, N.Y.; **Haim Mendelson**, the Theodore J. Kreps Professor of Information Systems and Management in the Graduate School of Business at Stanford University in Palo Alto; and **Jim Sutter**, senior partner at The Peer Consulting Group in Newport Beach, Calif., and former CIO of Xerox Corp. and Rockwell International.

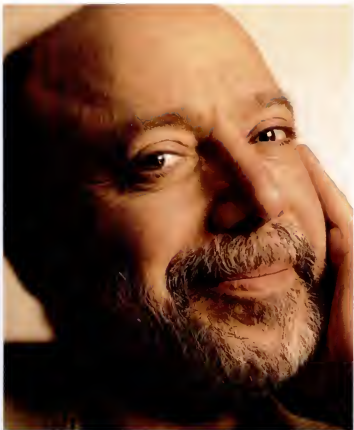
In this future world, the participants foresee the disappearance of multinational conglomerates, the emergence of a global job-bartering community on the Internet, and a leadership style that will require expertise in corporate culture and employee motivation. And contrary to popular belief, they say, people will choose *not* to do all their work at home.

BY POLLY SCHNEIDER

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CIO: How will corporations evolve over the next few decades?

Paul Horn: The changes we'll undergo are going to be quite phenomenal and startling. The companies of 2025 will, in my opinion, not look at all like the companies of today. Twenty to 30 years from now you're going to be able to buy a terabyte of data storage for a dollar. When we invented the first disk drive in 1954, a giga-



“The whole concept of the virtual enterprise is going to explode”

—Paul Horn

byte of storage cost \$10 million. So the whole concept of the virtual enterprise is going to explode. We'll have companies with little or no physical assets, with business models that are completely intellectual-property-centric, with essentially the entire technological infrastructure outsourced. Business models are going to be all based on rapidly turning data that's stored digitally on these “yada-bytes” of storage into useful corporate knowledge.

Halm Mendelson: We're going to see companies that are looser coalitions than the companies of today. If we talk about the corporation of the past, the prototypical successful company was a large, vertically integrated company that controlled an entire value chain. Today, these companies essentially are breaking down into components, where each does a piece of that value chain, and ultimately these pieces are integrated to create a final product. I think we're going to see this process continue on a very large scale.

One type of company will specialize in development, where the focus is knowledge work. It will be managed much the way Internet startups are managed. The second type of company will focus on physical production, where economies of scale and managing physical assets are important. We'll see even tighter control in

these types of companies. A third type of company [will be] in the distribution business, where you see some integration of physical movement and of components. The closest to that is something like Ingram today, but it's difficult to predict what exactly it will look like because this structure is just evolving. The fourth type will be the ultimate aggregators: people who specialize in customer relationship management. Their key competence is going to be managing information about customers and providing high quality service. These are very different types of companies that require different skills, which is one of the reasons they need to be separated.

Anita Borg: I hope and think that one of the major changes in corporations will be that we will get to the point where women have significant roles in nearly equal numbers to men. That, in and of itself, will have a lot of interesting impacts on what corporations look like, because it will no longer be the case that women are exceptions



“We will get to the point where women have significant roles in nearly equal numbers to men”

—Anita Borg

or very much outnumbered. There will be a much more relaxed sense of inclusiveness. [For more on the role of women in the future of the organization, see *Trendlines*, Page 28.]

CIO: But will people care so much about belonging to an organization? There's a lot of talk about the temporary company—a specialized group of people that come together only for the length of a project.

Jim Sutter: Years ago, you'd go off and do research, contribute ideas and create a new product. Today, to minimize the risk, in part, and also to provide rewards for those who take the risk, a new entity is often created—to develop an Iridium or whatever it might be. So I think corporations of the future will be much more built out

of pieces that kind of come and go, if you will, as alliances are created and equity is generated. There will still be very large companies, but I think they'll be federations of smaller businesses that can be easily reconfigured or spun out or sold.

Mendelson: On the demand side, there's the need for temporary, virtual companies because the capabilities needed are changing so fast. You can't really form a group of people that will satisfy next year's demand. There will be a people's directory on the Internet, so that if you want to put together a company with a set of given skills, you go to this global employment agency that has information about millions of people. The agency will go and talk to candidates and try to convince enough of them to join the new operation. They do their job, they may continue into a couple of other generations of the product, and then they move on to another activity. The problem is, if we have a product that's created by a large number of components,

what do you do if a component fails, for example? When the people have moved on to something else, it's very difficult to figure out which component is at fault. So the complexity of managing this type of operation is an order of magnitude higher than the complexity of managing today's operations.

CIO: How will managers lead in these increasingly chaotic and loose structures?

Horn: I think the biggest management challenge will be creating a unified corporate culture: pulling together something with a corporate value quickly—a group of people, very disparate, perhaps around the world, and then instilling some level of value system. Business models will come and go

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Leadership skills may become less important in the future



—Haim Mendelson

more rapidly, so the whole thing strikes me as being far more ephemeral.

Mendelson: Leadership skills [may] become less important in the future because more of the decisions will be based on the rational analysis of information that gets presented. The information makes the decision as opposed to the personality. But the second perspective says, well, everybody's going to have more information, so the source of competitive advantage is actually going to be those intangibles—the ability to get people to follow through a vision, the ability to create a vision that cannot be supported by data, the ability to create a market that doesn't yet exist—and we need to do that through our personality. So there are two perspectives, and I don't know which is the right one.

CIO: What kinds of tools do you think we'll be using in the workplace?

Horn: First of all, the core underlying technologies, which are mostly optical and semiconductor technology and displays, are going to get better exponentially than they are today—following something that's close to the existing Moore's Law [stipulating that the data storage capacity of microchips doubles every 18 months]. Also, object-oriented programming and Java are going to allow people to build applications fundamentally faster than they used to build them. In 2025, you'll be able to pull together components that'll interoperate and build a complex solution like well-defined little pieces. Just the way we can do it in silicon technology with circuits, you'll be able to do it with software programs. More and more, the technology is going to be invisible. It's going to be easier to use, and it'll be all around you. We're already starting to see today what we call the dawn of the

post-PC era. It's really more correct to think of your digital phone as a client on the Internet than a phone, for example.

Mendelson: The first wave of technology will be to replicate daily activities in a virtual environment. Say we want two people to be able to speak to each other over the network. We'll have low-cost storage so we can

day. I talk to senior executives who say there's this expectation that you enter your e-mail 24 hours a day, which is bonkers.

Sutter: Virtual companies and offices will grow—I just don't think the result will be that people will stay at home. We offered that to our people at Rockwell, and it was surprising to me how few people were interested. People will want to go to an office that's convenient, however. One of the things companies will have to face is [the fact that]



Virtual companies and offices will grow—I just don't think the result will be that people will stay at home

—Jim Sutter

bring back a discussion that we had two weeks ago and pop it up on the screen as we're talking. Then the question is, To what extent can we replicate the different senses on the Internet—as far as smell and touch? In 20 years we'll have these technologies actually working in a way that surpasses the quality of face-to-face communication today, and we won't pay a penalty for assembling a company with people who are physically located in different places.

CIO: So will most people work out of their homes?

Borg: The Internet is in a baby stage right now, and the kind of communication that will be enabled will certainly change the way things are structured, although I don't believe it will eliminate offices or face-to-face work. I think that there's something inherently rich about that, that we're not going to be willing to give up. But it may move corporations to an even flatter structure, with smaller pods of people spread around. I don't think people are going to be all that happy spending all their time working at home. If the pendulum swings toward a time when lots of people are flocking to work at home, they're suddenly going to find out that work is 24 hours a

it's going to be increasingly difficult to define the workday. From your workstation, you can do your financial planning, take a course, do shopping and so on. For me, it might be that I work through the evening. But I do think people will be just as productive, and in many cases, more productive.

CIO: What changes might we see in the global economy?

Borg: The whole notion of a knowledge economy is one that has quite different dynamics than an economy based on physical stuff. Stuff is finite, but knowledge is infinite. There's no limitation to its volume or its tradability. Potentially, there's room for a lot more people to be supported by it. I think there's going to be an enormous growth in this knowledge layer, and if we're really lucky, it could have an incredibly positive impact on the world economy. The problem with the imbalance in the world economy is not a lack of resources but a lack of distribution, because the folks on the other end don't have anything to trade. Well, in a knowledge economy, maybe they do. **END**

Senior Writer Polly Schneider can be reached at pschneider@cio.com.



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Without the contributions and creativity of these inventors, who knows what the CIO's world would look like today ♦

INVENTING THE ENTERPRISE

BY TRACY MAYOR

OPEN STANDARDS. PORTABILITY. SCALABILITY. CONNECTIVITY. THE INTERNET. The spreadsheet's eternal A-B-C, 1-2-3. We consider these truths to be part of our fundamental technology rights, but somewhere, at some time, someone had to sit down and invent each one.

The CIO wouldn't be in the driver's seat of a company's future without the holy triumvirate of the 1960s and early 1970s—Unix, TCP/IP, Ethernet—and the departmental-empowering VAX minicomputer. We use Java to let our applications loose on the Net, but before Java there was Notes, which broke the database box and reinvented it as something more fluid. VisiCalc took numbers out of the back room and put them in the hands of the people who wanted and needed them most, and RISC processors revved them all up to a fever pitch and beyond.

What is it that inspires, or allows, someone to invent something as bedrock as packet-switching, as seminal as the Internet protocol? Necessity—that is, personal necessity. Unix, TCP/IP and Ethernet all started life as internal solutions to departmental problems, with no thought of the marketplace beyond. Java was the programming language for a project that never made it to the marketplace; Notes' most popular feature, database design, was initially built in for its developers' use only.

To a man (and they are all men; for a look at two women's contributions, see "Missing in Action," Page 130, and "Touched by Grace," Page 148), these developers acknowledge the crucial role that collaboration plays in technological innovation. James Gosling goes with Java, but behind him was Patrick Naughton and Wayne Rosing. Ray Ozzie wrote Notes, along with Len Kowell and Tim Halvorsen. Dennis Ritchie and Ken Thompson go hand-in-hand into the Unix hall of fame, but Bell Labs' stalwarts Steve Johnson and Brian Kernighan deserve a hand as well. If technology be the stuff of life, gentlemen, play on.

Tracy Mayor is a freelance writer based in Beverly, Mass. She can be reached at tmayor@shore.net. Additional research and reporting by former Senior Editor Howard Baldwin, Features Editor Sandy Kendall and Senior Writer Sari Kalin.

the past
decoding
inventing the
FUTURE

READER ROI

ENTERPRISE COMPUTING JUST didn't fall out of the sky. People have been laboring to invent what we now take for granted since the Nixon administration. Read this story for

- ♦ Insights on 30 years of technological advancement
- ♦ Perspective on today's technology wars
- ♦ A sense of what sparks innovation

INSPIRATION Having worked on DEC's Program Data Processor (PDP) minicomputers in the 1960s, Gordon Bell returned to the company in 1972 to engineer their replacement, the VAX. The popular PDP-11 was hitting a wall technically due to its insufficient 16-bit memory address, which had been extended a couple of times but was due for a complete re-engineering. "It was very difficult to really use effectively," Bell explains. "We simply couldn't extend [the PDP-11] to be a serious computer without a major overhaul." So he set to work on the VAX-11, which stood for the PDP-11's Virtual Address eXtension.

INNOVATION The VAX's roomy 32-bit address space was equally adept at accommodating real-time and personal computing applications, and the machine included a PDP-11 mode, thereby championing the concept of backward compatibility. As well, the machine was designed from the outset to be Unix-friendly. "The only outsider who the... design team invited to review the architecture was [Unix codeveloper] Ken Thompson," Bell remembers.

Bell was also the principal architect of "the VAX strategy," a plan within DEC to offer various VAX models and cluster machines to cover the entire range of personal, departmental and centralized computing, a concept that is

coming back into vogue. "Clustering is being rediscovered as we speak," notes Bell. "It is the only way to have truly reliable, scalable computing."

IMPACT The VAX gained share first in the technical market, where its superior performance and virtual address space won converts, then moved on to capture corporate business with commercial and time-sharing applications. In both cases, the machine's size and price—between \$50,000 and \$500,000—were instrumental in allowing it to fly below the radar of the mainframe computers, which cost anywhere from \$250,000 to \$10 million. "There's a whole lot of computing sociology that goes along with the VAX," Bell observes. "At a departmental level, people wanted control of their machines, they wanted to control their own applications and their own resources."

INSIGHT Bell's only regret about his creation centers around the way DEC handled VMS, the VAX's widely installed and popular operating system. "There was no way to port it to other platforms," says Bell. "We should have made it more architecturally neutral." (David Cutler, the principal developer of VMS, eventually went to Microsoft to work on Windows NT, which was designed to run on multiple processors.)

As for the minicomputer itself, Bell says its gift to the enterprise was the idea of departmental autonomy, a concept carried on today in products like Sun servers and Oracle databases. "Sun, in my view, has taken over DEC's position as the departmental company," says Bell. But it was the VAX that "pioneered the notion that a small, departmental-level machine could do serious commercial processing."

THEN
Developer, VAX
Minicomputer, 1978,
Digital Equipment
Corp.

NOW
Senior Researcher,
Microsoft Corp.,
Los Altos, Calif.

Gordon Bell



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Missing in Action

Whenever there's a list—whether it's best acting newcomers or technology innovators—there's someone who says, "Hey, why didn't you include so-and-so?" In response, we say: We tried. Here are some of the folks we either couldn't find or who declined to participate.

RISC PROCESSORS David Patterson also credits former Stanford University researcher and MIPS founder John Hennessy with RISC advancements; Hennessy has just been promoted to provost of Stanford.

INTERNETWORKING Once upon a time, married researchers Sandy Lerner and Len Bosack worked at Stanford, but in different departments and on different networks. When they discovered they couldn't even send e-mail to each other, they took it as a challenge and created internetworking. Oh, and a little company to commercialize it, which we now know as Cisco Systems Inc.

VMS David Cutler created the VMS operating system while at Digital Equipment Corp. and now leads Microsoft Corp.'s Windows NT team.

PERSONAL COMPUTER The man behind MITS, the company that sold the first personal computer, sold his company in the 1970s and went in a completely different direction. Ed Roberts, president of Altair, earned his MD and became an emergency room doctor. Currently practicing in Georgia, he also has a software company that develops medical-office software.

RELATIONAL DATABASES If anybody knows the whereabouts of Edgar Codd, the IBM researcher who first put forth the idea of a relational database, please let us know.

—H. Baldwin and S. Kendall

Vinton G. Cerf

INSPIRATION Vinton Cerf was a graduate student at UCLA in 1969 when a government contractor, Bolt Beranek Newman (BBN; now GTE Internetworking Inc.), built and delivered the first node of a new government/research network to the university—the Internet.

It was the first time anyone had successfully demonstrated that packet-switching—the quick delivery of small, discrete data bundles over telephone lines—worked on a wide area network. It was also the beginning of ARPAnet, the agency's network, and a movement to allow the various research centers in government (specifically, Defense) and universities to

be able to share data easily without having to revamp their computer systems.

Cerf had graduated and was working at Stanford University in 1973 when

THEN
Codeveloper, TCP/IP,
1973, DARPA

NOW
Vice Chairman,
MCI Worldcom,
Washington, D.C.

Robert Kahn, a former BBN employee who had moved over to DARPA after the UCLA demonstration, came to visit. "We talked about these various networks he was working on and how to get them to communicate over heterogeneous systems and about interconnecting multiple packet

networks," Cerf relates. The pair began tackling the problem. "The principal motivation was how to let people do computer science more readily," says Cerf. "We had to overcome the hetero-



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generosity of computers with different operating systems needing to communicate."

INNOVATION Kahn and Cerf completed an initial design document, which they presented informally at a conference and then published the next year, 1974, in an IEEE publication.

"As far as networking was concerned, 1974 was an amazing year," Cerf recalls. "That was the year a team of graduate students and others, some from Xerox PARC, participated in a more detailed design of the idea that we had published in May. That was really the beginning of TCP." The connection-oriented transmission control protocol was designed to provide reliable communication and multiplexing; the

Internet protocol provided packet routing. The result: TCP/IP.

IMPACT After eight years of new iterations, testing and implementation, DARPA set a deadline for switching from ARPAnet to Internet architecture, and in 1983 TCP/IP was finally rolled out to ARPAnet and all networks attached to it. For his part, Cerf thought the work was done. "I didn't really see a commercial potential for all this until 1984," he says. "That was the year [Internet router provider] Cisco [Systems Inc.] was founded. I was impressed that someone would take it up as a commercial endeavor."

INSIGHT "The Internet has become a substrate for all other communica-

tions," says Cerf. "By 1990 it was becoming clearer it could be viable commercially, but I don't think any of us had any idea of how far it would go."

Cerf sees interactive Internet radio and television just around the corner and envisions a whole range of Internet applications that haven't yet been dreamed of—including Internet-enabled refrigerators, bathroom scales and even an interplanetary Internet. "Think of it this way," Cerf says. "ARPAnet is a network of computers. The Internet is a network of networks. An interplanetary net would be a network of Internets." The sky's the limit. (For more on Vinton Cerf, visit www.wcom.com/about_the_company/cerfs_up/.)

THE FATHER OF THE PC REVOLUTION

Philip "Don" Estridge

The personal computer enjoys the ubiquity it does because of one man: Philip "Don" Estridge. An IBM employee since 1959, Estridge headed up the skunk works in Boca Raton, Fla., that in 1981 launched the IBM PC. Estridge made the decision—revolutionary for that time and place—that the machine would be made from off-the-shelf, easily obtainable parts and that the design specification would be made public. Estridge and his wife Mary Ann died in the Aug. 2, 1985, crash of a Delta Airlines L-1011, which was hit by wind shear while landing at Dallas-Fort Worth Airport. Estridge's longtime friend, neighbor and coworker Jan Winston, now retired but still consulting with IBM, talked to CIO about the colleague he still misses.

DON AND I LIVED NEXT DOOR to each other in Boca Raton. It was a sleepy town in those days, not sophisticated like it is today. Then, it was only old people and IBM employees. You could stand outside watching the kids play and have a departmental meeting. Our families were very close well before the PC project started; he and I had worked together on the Series 1 project, IBM's first minicomputer. Because we had different responsibilities, we were often in contention on that project, but there was no stress in our friendship.

Don was very human, with a wonderful sense of humor and a charming personality. He combined a manic drive

with tremendous respect for his people, recognizing all that they were sacrificing during the PC project. When the PC took off, it was like a rocket ride, and he did a wonderful job



of exerting executive leadership. And he was a technically competent visionary. Don had a very broad view of where computer business was going technically as well as the importance of computers to the economy and to society as a whole.

Would the world today surprise him? Its magnitude would. Our first sales projections estimated selling 250,000 units over three years. The executives wondered what we were smoking because the best-selling IBM computer had sold only 25,000 over three to five years. We always said to ourselves that the technology would grow by leaps and bounds because of applications like VisiCalc. We knew there was going to be e-mail too. But the broad acceptance of the computer, the way it embedded itself in our everyday lives and the explosion of the Internet, is an order of magnitude beyond what we were thinking about in the early '80s.

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Dennis M. Ritchie

◆ **INSPIRATION** In the late 1960s, Bell Labs was beginning to pull out of a shared network project, called Multics, that it had conducted for many years with General Electric and MIT. "The question arose," recalls Dennis Ritchie, who had worked on Multics at MIT, then followed it to Bell Labs, "what do we replace it with?" Programmers liked the time-sharing and interactive nature of the system. With those hallmarks in mind, and a desire to build an operating system from scratch, Ken Thompson began work on what would eventually become known as Unix (as in, a singular Multics). "The intent was not directly to produce a product," says Ritchie. "We were building ourselves a tool."

INNOVATION What became widely adopted inside AT&T Corp. and then later in the marketplace was a multiuser, multitasking operating system with strong text-processing and natural language aspects.

Then in the late 1970s, Unix entered a second phase of innovation: portability. It was a pain to interface with the operating systems of non-Unix machines like the IBM System 360 and the Honeywell 600 and 6000 series machines, says Ritchie. "The system was not initially designed to be portable, but I sat down with [fellow Bell Labs researcher] Steve Johnson and said, 'All of this is done in a higher-level language—C—why not port the operating system itself?' Their first choice of machines:

the DEC VAX, a happy coincidence, since, as Ritchie points out, "the VAX was to the '80s what the PDP-11 had been to the '70s."

IMPACT Before AT&T was forced to break up, it received permission to sell Unix outside the company, the OS enjoyed initial success in the marketplace due in part to its simple, low-resource design and in part because it ran on the popular DEC PDP-11.

Then in the 1980s, the newly portable Unix grew two heads and bifurcated in the market: The University of California at Berkeley won a grant from DARPA and began working on its own implementation of Unix, known as Unix BSD, with help from Ken Thompson. Then AT&T, postdivestiture, decided to

evolve its own version and produced a Unix that came to be known as System V. Major companies like Sun and IBM chose different versions on which to base their versions of the OS, and thus began the Unix Wars, a divisive and distracting battle that benefited neither side.

INSIGHT Long term, Unix recovered sufficiently to retain a significant share of the marketplace. "Except on the desktop, Unix penetrates pretty much everywhere," says Ritchie. "From a technical point of view, the portability was very important and still is."

He is most happy, he says, about Unix's role in jump-starting the nascent workstation industry, as exhibited by companies such as Sun Microsystems and Silicon Graphics Inc., and later Hewlett-Packard Co., which all brought out high-end workstations running Unix.

As for the different versions of Unix, Ritchie says simply, "There should have been more cooperation." (For more on Dennis Ritchie, visit cm.bell-labs.com/cm/cs/who/dmr/.)

THEN
Cocreator, Unix, 1969,
Bell Telephone
Laboratories Inc.

NOW
Head of System
Software Research,
Computing Sciences
Research Center,
Lucent Technologies,
Murray Hill, N.J.



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INSPIRATION In the early 1970s, the folks at Xerox PARC had a couple of problems to tackle. Internally, the research center had just developed what's regarded as the world's first laser printer, a one-page-per-second, 500-dot-per-inch unit that was capable of handling everything Xerox workers threw its way, and then some. "The printer was fast. The question was, how could we possibly keep that printer busy?" says Bob Metcalfe, who was hired on from MIT as a networking expert.

On the larger front, Xerox was interested in getting hooked up to the ARPAnet, the up-and-coming academic and government research network sponsored by DARPA. PARC had hooked up its two refrigerator-size minicomputers easily enough, but it was too much work for too little gain to hook up every one

of the organization's PCs directly to the ARPAnet. What was needed was a way to hook the smaller computers into the minicomputers while simultaneously gaining print and file-sharing capabilities internally.

INNOVATION "We needed something that was fast, could connect hundreds of computers and span the whole building," says Metcalfe. Something like a local area network, which Metcalfe developed in a rudimentary form in 1973 and dubbed Ethernet. The original Ethernet sent 2.94 Mbps (roughly a paragraph) of data over thick coaxial cable at a distance of one kilometer. Ethernet incorporated a feature dubbed "carrier sense" that instructed individual computers to

listen before they sent data packets, thereby upping the chances of data getting through without a collision on the first try.

IMPACT The concept of the LAN caught on quickly, but Ethernet ensured its place in history when it became an open standard. "Intel wanted to sell chips, Xerox printers and DEC minicomputers. None of us planned to make money selling the network, so making it an open standard was not a big risk," Metcalfe explains. The specifications the three produced were later accepted in modified form by the IEEE.

Metcalfe went on to cofound 3Com Corp. (computers, communications, compatibility), which promulgated the idea of using standards like Ethernet and TCP/IP to foster connectivity. And the Ethernet standard itself, which has undergone more reinventions than Madonna, is still a force in networking. "Ethernet is still chugging away out there," observes Metcalfe, "due in part to switched Ethernet and fast Ethernet."

INSIGHT Ethernet's most important legacy is the Internet itself, says Metcalfe. "Ethernet is the on-ramp for the Internet. TCP/IP and Ethernet were both

invented in the same year, and they both grew up together." On the business front, Ethernet showed that companies could embrace open standards and still make money. Metcalfe's biggest regret? His inability in 1980 to convince IBM to adopt Ethernet instead of Olof Soderblom's competing Token Ring technology.

"Ethernet shipped five years ahead of Token Ring, but IBM was the Microsoft of its day then, so Ethernet had to go up against that," says Metcalfe. "It was the first big battle [IBM] lost."

THEN
Developer, Ethernet,
1973, Xerox Corp., Palo
Alto Research Center

NOW
Vice President
Technology,
International Data
Group, Boston

Robert M. Metcalfe

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Daniel S. Bricklin

INSPIRATION "Recalc" was the driving force behind the world's first PC spreadsheet, says Daniel Bricklin, who co-created VisiCalc along with Bob Frankston after attending MIT and Harvard, with a stint programming word processors at Digital Equipment Corp. in between.

In the late 1970s, people—mostly secretaries—were just beginning to use word processors, which for the first time allowed ordinary users to make changes that were instantly incorporated into a document. But no one had yet brought that level of interactivity to the world of numbers.

Business schools extolled the virtues of constant what-if calculations, says Bricklin, but on mainframes, that meant sending off one set of numbers, waiting for its return, then preparing and sending off another set. Not exactly interactive, yet from his exposure to lighting fast games and flight simulators on the big machines, Bricklin knew the powers of interactivity first hand.

INNOVATION The challenge was to design a program so beneficial that it justified the initial front-end burden of data entry. Developing the interface was the primary challenge—"I was the one who decided on that A-B-C, 1-2-3," says Bricklin—as was programming the output to approach true WYSIWYG (what you see is what you get). Thus was born VisiCalc, an easy-to-use PC-based calculation engine with built-in formatting tools (check out Bricklin's Web page at www.bricklin.com for a look at an original version of the program).

IMPACT VisiCalc took off like a shot in the marketplace. "In hindsight, when you realize how long it takes for even the best of things to percolate through the ranks, VisiCalc was quite fast," says Bricklin. Some people instantly understood the potential of what the tool could bring to a world anchored by green-checked ledger sheets. "I went to demo it in front of the IBM executive committee, and Don Estridge got it right away," he says (for more on Don Estridge, see "The Father of the PC Revolution," Page 132). "Apple, of course, benefited from it, as did a lot of other manufacturers who put it on their machines."

INSIGHT The little spreadsheet that could was eventually overtaken in the marketplace by the world's first killer app—Lotus 1-2-3 running on the IBM PC, which itself has been pushed down the charts by Microsoft Excel.

So what's VisiCalc's legacy to enterprise computing? Inspiration to two

groups of people that play a dominant role in computing today: programmers and the average business people, who came to be known as end users. "There are a lot of people in the industry today who first understood the power of interactive computing through VisiCalc. It made them want to get into the business." As to the now-ubiquitous end user, VisiCalc was "like modeling clay," says Bricklin. "You could program without knowing it."

THEN
Cocreator, VisiCalc,
1979, Software Arts
Inc., Cambridge,
Mass.

NOW
Founder and Chief
Technology Officer,
Trellix Corp., Waltham,
Mass.



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INSPIRATION When Tim Berners-Lee was at CERN in the late 1980s, the Internet had spread from U.S. universities into Europe. But trying to retrieve information from a Net-connected computer was often an exercise in frustration, thanks to incompatible computer systems. "You could connect to a library site, and if you understood how to use the program that ran on the library system...you could perhaps locate some information," Berners-Lee recalls. "When you downloaded it, it would be something somebody had written using some program you didn't have, and you'd have no way of processing it."

INNOVATION Berners-Lee's innovation was to marry the Internet with hypertext to form the idea of global access. He realized that the complicated recipe for retrieving a file from an FTP site contained only a few variables: the name of the computer, the directory and the file's name. Berners-Lee took those variables and made a short document name out of them—what he called the URI (universal resource identifier), what was later called the URL ("L" for locator). "If you take that name of the document and put it behind a link in a hypertext document, then the machine can do all the work for you," Berners-Lee says. "You realize that all these systems, which are different in different ways, could in fact be Web sites, and they could all represent their information as a sequence of Web pages." The system would also have to be completely decentralized, so it could scale and run on machines of any size.

IMPACT In 1989, Berners-Lee wrote a proposal at CERN to develop the World Wide Web. The following year, after being unable to convince any commercial hypertext software manufacturers to retrofit their products for the Internet, he developed hypertext transfer protocol (HTTP), hypertext markup language (HTML) and the first Web browser/editor, called World Wide Web. To spur interest from other programmers, he put

his programs on the Internet. Grad students began developing browsers as student programming projects, and the Web began its exponential growth—and, eventually, commercial growth. "It was always difficult to predict how fast it was going to take off or whether it would crash," Berners-Lee says. "We just kept our fingers crossed." Rather than start his own company, Berners-Lee formed the nonprofit World Wide Web Consortium, which he now directs, to watch over the Web's development.

INSIGHT Berners-Lee envisions the Web becoming a more collaborative medium, where people can create Web documents and edit each other's documents as easily as they can browse through them. He also sees the Web becoming a machine-to-machine communications system, using XML tech-

nology as a foundation for what he terms "the semantic Web." Today, Web pages contain vast information in a form that humans can browse but that

machines can't understand as data. In the future, a developer will be able to write a Web application that can, for example, automatically check supplier catalogs for a particular part and make sure it's bringing back catalog pages for items that are exactly compatible with the desired part, even if one supplier calls

the part a hex-head bolt and the other calls it a machine screw. This type of machine-to-machine interaction will be as exciting for business-to-business electronic commerce, he says, "as the revolution of the World Wide Web was for breaking out of individual documents and books into a whole Web of information."
—S. Kalin

THEN
Inventor of the World Wide Web, CERN, The European Laboratory for Particle Physics, Geneva, 1989

NOW
Director, World Wide Web Consortium (W3C), Cambridge, Mass.



Tim Berners-Lee



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INSPIRATION In the early 1980s, the VAX was the king of the computing hill, and its rich instruction set—the set of instructions recognized by the processor—worked just fine. Computer architecture design was driven by intuition rather than by quantitative analysis, and it simply seemed to make sense that a larger, more complex vocabulary would yield faster processing. Except it didn't make sense to David Patterson. "I started to wonder just how much advantage you get from a large vocabulary," Patterson says. "Wouldn't a leaner vocabulary work faster?"

INNOVATION Patterson developed RISC, a simpler set of instructions that in theory could be executed much faster—say, in a single clock cycle—thus producing a faster machine with better performance. The theory alone was enough to ignite a fever pitch of controversy among computer designers and manufacturers. "There was a great deal of heated debate," Patterson recalls. "It was the intuitive crowd versus the quantitative."

Work began separately in three places—Berkeley, Stanford and IBM Research Labs—to develop prototype chips and computers that could quantitatively show better performance. By 1983, enough working hardware did show improvements to shift the nature of the debate. "The arguments changed

from, 'This is a stupid idea,' to 'OK, it has a technological advantage, but does it have any business advantages?'" Patterson recalls.

IMPACT IBM built and in 1987 marketed a RISC machine—the RT PC—that was hobbled by a high price tag. "The RT PC was a turkey," Patterson says. "That was the nadir of RISC's reputation." But the year before, John Hennessy, who had worked on RISC at Stanford University, had started MIPS Computer Systems Inc., an independent company dedicated to producing RISC processors. MIPS made enough of a ripple in the market to convince Sun to give RISC a try (though not with MIPS' chips).

With Patterson as a consultant, Sun developed its Sparc (scalable processor architecture) CPUs and, as Patterson puts it, promptly began to blow DEC out of the water. "At half the price and double the performance, Sun was just eating DEC's lunch, and they were making a lot of money at it." That last point, profit, was the boost that RISC needed to be validated in the marketplace,

Patterson says. "Once someone starts to make money, then everyone else says, 'Oh, damn, I guess we'd better change.'"

INSIGHT The average business PC still isn't a RISC machine, but RISC dominates in the hypergrowth market for embedded chips, and it owns a big chunk of the Internet server market as well. And to computer engineers, RISC represents a triumph for quantitative design, Patterson main-

tains. "Intuitive design is gone," he says, "and as a result of being more scientific, computers are incredibly faster than we would have anticipated."

THEN
Creator, RISC, 1982,
University of California
at Berkeley

NOW
Professor of Computer
Science, University
of California at
Berkeley; Chief
Scientist of Network
Storage, Sun
Microsystems Inc.,
Mountain View,
Calif.

David Patterson

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Ray Ozzie

INSPIRATION In the late 1970s and early '80s, Ray Ozzie was a twentysomething programmer working for Data General and wondering what happened to his dream of electronic interaction via the personal computer.

As undergraduates at the University of Illinois in 1979, Ozzie and his buddies had been wowed by Plato, a computer-based teaching system with 10,000 orange-plasma screens hooked up to a mainframe. It featured a real-time talk system, rudimentary e-mail and a "group notes" capability—all revolutionary ideas at the time.

Then everyone graduated and joined the world of high technology, which for Ozzie meant office automation and data

processing. "My friends and I all said, 'Why aren't people using these computers for what we know they're good for?'" recalls Ozzie. "I wanted to build a system that fostered human interaction. I was too young to understand that there might also be a business need for such a thing."

When he joined Software Arts, the birthplace of VisiCalc, (for a look at Daniel Bricklin, see Page 140) Ozzie was already working on a software project in his head. By the time he was asked to join Lotus Development Corp. in 1983,

Ozzie was sketching out a business plan for his own company. When he finished work on Symphony, Lotus's integrated spreadsheet package, founder Mitch Kapor funded Iris Associates and set Ozzie loose to create what would become Lotus Notes.

INNOVATION Nearly five years later, Iris finally released Notes, a document-sharing, network-based communications environment that acknowledged people work in diverse locations, even on the road. At the time, in 1989, people used graphical interfaces primarily for desktop publishing; networking was limited to file- and print-sharing; and data was something you kept in a relational database. The highly graphical Notes was built around the concept

THEN
Creator, Lotus Notes,
1989, Iris Associates

NOW
President, Groove
Networks Inc.,
Beverly, Mass.



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that unstructured data—notes, pictures or any other kind of object—could be stored in user-created databases and shared by various groups of workers, including those in remote locations. “Call it groupware or messaging or whatever, it was relationships I was after,” says Ozzie.

IMPACT Lotus Notes hit the market amid the business process reengineering movement of the early '90s, and many companies bought Notes as part of

widespread corporate cultural change. Some places used Notes only for e-mail; other Notes sites pushed the product to its limits, exploring its product management and application server capabilities. “We didn’t realize how important the notion of customization would be to users,” says Ozzie. “Initially those tools were built in for our own use in the development of applications.”

INSIGHT The advent of the Web and intranets across the enterprise has stolen

some of Notes’ thunder in the marketplace, but corporate Notes installations are still plentiful and the package remains Lotus’s strongest product. Ozzie is most proud of the way Notes was used to help companies take business advantage of information technology. “Notes broadened communications within and across organizations. It helped them to be ‘fast’ companies in that era when there weren’t many alternatives.”

TOUCHED BY GRACE

Grace Murray Hopper

Though Pamela Coker met Cobol developer Grace Murray Hopper only for one night 15 years ago, the meeting inspired the founding of San Diego-based Acucorp Inc., which today offers versions of Cobol multiple operating systems. Coker is its president and CEO.

IT WAS A COLD FEBRUARY DAY IN 1984. I was on my way to Newport, R.I., to deliver a speech at a Navy conference on knowledge-based systems when 18 inches of snow stranded me at O’Hare Airport for the night. When I eventually arrived at the conference and began my speech about how techniques in artificial intelligence could be used to help synthesize information from raw sensors on the battlefield into meaningful information, I discovered I was the only woman in the room of 100 Navy brass.

The next day three more women arrived: Rear Admiral Grace Hopper and two of her aides. Of course, I had heard about Grace Hopper, the inventor of Cobol and discoverer of the infamous first bug in a computer (it was a moth). Watching her in action and listening to her rousing motivational speech was a real treat. She was 78 then and two years away from forced retirement. I was 35 at the time and amazed by her extraordinary energy and presence. She died in 1992 at 85.

After receiving her PhD in mathematics from Yale and teaching at Vassar, Grace joined the Navy Reserve at age 34. She had to fight her way in because she was considered too old and too light at 105 pounds. She had Navy officers in her family and revered the Navy, so this motivated her to challenge the system, and she continued to buck trends

and break the rules. I believe it was Grace who first said, “It is easier to apologize than to ask for permission.”

Excellence and service were part of everything she touched. Forty years ago she formed a Codasyl committee and designed the most successful language in the history of computing. Cobol succeeded because it was designed to be portable, reliable and easy to maintain with excellent data handling and performance. These continue to be its strengths. Once it was developed, she persuaded the Pentagon to require Cobol on all computer procurements. That’s



why, to paraphrase Mark Twain, reports of Cobol’s death are greatly exaggerated.

Grace’s “Dare and Do” slogan must have touched me that day in 1984, for five years later I founded a Cobol company with my brother, Drake Coker. Grace Hopper’s longevity and continuous innovation are the perfect metaphor for Cobol. Since she first created it 40 years ago, Cobol has evolved to meet the needs of business programmers, and it is just as powerful a tool today as when it was first invented.

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James Gosling

INSPIRATION James Gosling calls Java, the hot programming language of the Internet, "a really fancy wrench for a weird sports car"—a car that never got past the prototype stage. In the early 1990s, Gosling and a group of elite, restive engineers at Sun convinced the company to let them loose on an ambitious, undefined project to develop what Gosling refers to as "funky, distributed systems"—platform-independent devices that could be sold into the consumer marketplace or to cable television, telephone or consumer-electronics companies.

The team worked first on a handheld device roughly analogous to today's Palm computer, and, later, under the auspices of a separate subsidiary, FirstPerson Inc., on a television set-top box that would allow cable companies like Time-Warner Inc. to build their own Web-like interactive television systems.

At the time, interactive television was as hot a space as the dot-coms are now, but because of hardware and economic constraints, those various race cars never made it to the marketplace, but Java, the programming language Gosling developed as part of the project, survived to live another day on the then-burgeoning Internet.

INNOVATION Early on, it became clear that C++, the programming language of choice, wasn't up to the networking and security demands of the Sun team's project, so Gosling wrote Java, then code-named Oak, to give the team the superior network and security features, and a higher degree of orderliness than C++. "It was really the first and only language designed around networking," says Gosling. "It was a whiz-bang fancy programming language for our use; we

didn't intend it for random people."

IMPACT In 1993, the set-top box deal with Time-Warner fell apart, leaving FirstPerson with no viable hardware product, an orphaned programming language and few apparent options. There was no single "aha!" moment, Gosling says, but over the course of several weeks in 1994, team members hashed over the idea of positioning Java as a tool for building applications for the Internet. It was auspicious timing; fledgling developers hungry for Internet applications picked up the ball and ran with it.

Though Gosling has never been amazed at Java's capabilities—those were programmed in at the start—he says he is continually amazed at the weird things people have built with his programming language out on the Internet. "If you asked me in 1991, could someone do something

strange with Oak, I would have said yes. But would anybody actually do it? I would have said no, not in a million years."

INSIGHT Java is just a baby relative to the long history of computing, but Gosling already envisions a few important imprints it will leave behind. Java

helped people change the way they think about distributed computing—intranets are considered a viable alternative to traditional enterprise networks, for example. In the programming world, Java helped break down hierarchies and open up closed communities. "It used to be that all developers were colored by the tools they used," he says. "But Java developers can work everywhere." **CEO**

THEN
Creator, Java, 1992,
Sun Microsystems Inc.

NOW
Vice President and
Sun Fellow, Sun
Microsystems Inc.,
Mountain View, Calif.



PHOTO BY WILLIAM MERCIER/MLC/OOD

Q

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When it comes to being a good CIO, graybeards and whippersnappers have a great deal of career advice to give each other. ♦

ACROSS THE GREAT D

CIO BRIAN FEUCHT COMES TO WORK EVERY DAY KNOWING THAT SOME of his subordinates will be out for his blood.

And he doesn't mind a bit.

Of course, it's virtual blood. Feucht, along with several of his IS staff members at Chicago-based outplacement firm Hire Quality, is an enthusiastic participant in "Half Life," a sci-fi computer game featuring sudden deaths and nefarious scheming. This might turn a few heads at many companies, where computer games are usually hidden from the boss, not shared with him. But Feucht, 28, sees things a little differently.

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- How next-generation IS executives are changing the role of CIO
- What lessons more traditional CIOs can teach—and learn from—their younger counterparts

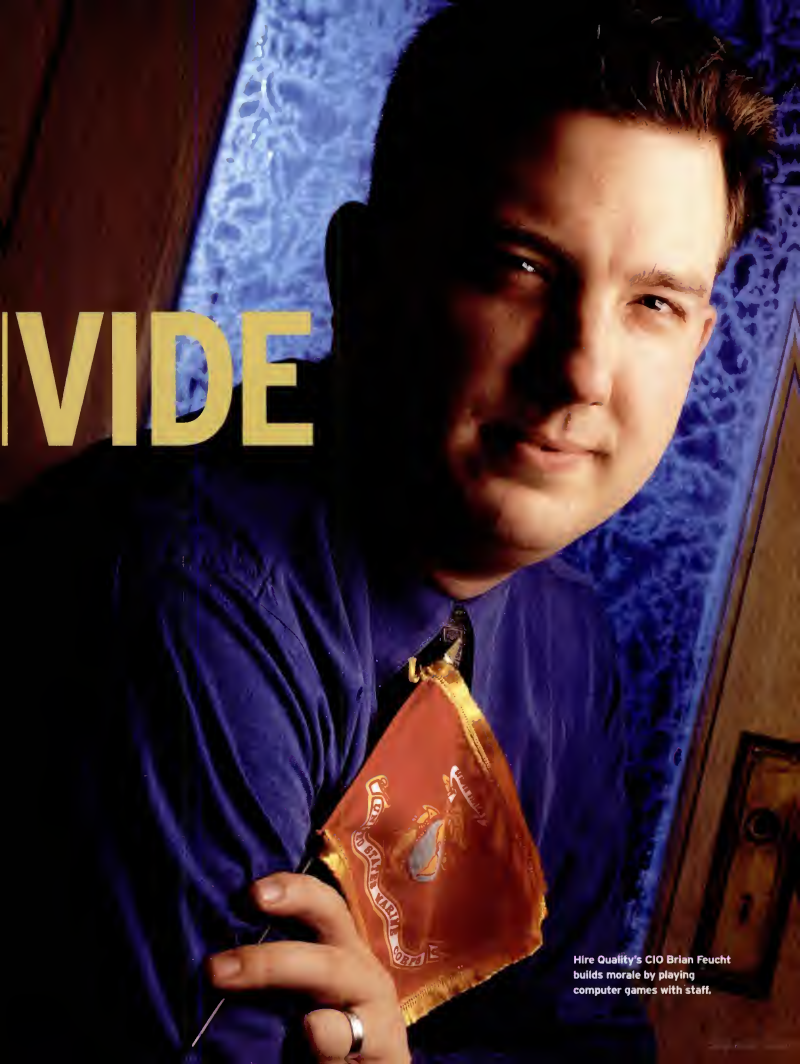
"How often do you get to kill the boss at work?" he asks. "My staff loves [playing the computer game]. It's a great morale booster."

This is the new, younger face of leadership. In times past, Feucht's passion for "Half Life," not to mention the fact that he spends office time playing it, would be taken as a sign of immaturity and mark him as a poor candidate for higher executive office. Today, however, Feucht's approach to building staff morale marks him as a guy with a grip on the zeitgeist.

And he's not alone. As more companies try to recruit business-literate CIOs, the title looks increasingly attractive to Young Turks who might earlier have dismissed it as a job for Poindexters. Demand for IT executives climbed from 7 percent to 10 percent of the overall executive recruitment market in 1999, according to New York City-based executive search firm Korn/Ferry International. What's more, many recruiters say that current business trends are breaking in favor of younger workers, including the rapid pace of technological and economic changes and the dizzying force of the Internet. Although no hard numbers are available, it appears that, anecdotally at least, more and more CIO positions are being filled by IT professionals younger than 40.

The CIO position is increasingly seen as

BY MINDY BLODGETT

A man with short brown hair, wearing a blue button-down shirt and a dark tie, is looking directly at the camera with a slight smile. He is holding a small, red and gold flag with a crest on it. The background is a blue, textured wall. The word "DIVIDE" is written in large, yellow, sans-serif capital letters on the left side of the image.

DIVIDE

Hire Quality's CIO Brian Feucht builds morale by playing computer games with staff.

“I’ve seen some younger hotshots fail because they were impatient and didn’t take the time to learn their way”
around the corporate boardrooms.

—Laraine Rodgers, Vice President, Emerald Solutions

a steppingstone to CEO, making it more attractive to younger, more business-inclined aspirants. This may explain why many younger CIOs haven’t climbed through the ranks of programmers. Some have come from business functions, like marketing or sales. Others, like Steve Black, the 37-year-old senior vice president and CIO at Physicians Health Services Inc., an HMO based in Shelton, Conn., first worked in the consulting industry. “IT has become more attractive to young people as there are more opportunities to be a part of the business strategy,” says Mark Polansky, managing director at Korn/Ferry (visit www.cio.com/forums/executive/counselor.html to read Polansky’s executive IT career advice column). “The CIO isn’t just a supporting actor anymore.”

Still, the more things change, the more they stay the same. According to Korn/Ferry recruiter Philip Schneidermeyer, many companies—particularly large corporations—are still looking for CIOs with a few gray hairs in order to benefit from their years of experience. Combine the notion that younger CIOs are coming on with the idea that older CIOs are still in demand, and you could assume that the two age groups could strike up quite a conversation across the generational divide.

You would assume correctly.

For example, Feucht is the first to admit that he still has a lot to learn. Being a young, first-time CIO, he says, is a bit like “sticking a firehose in

your mouth. You are just bombarded with new things every day, and you are trying to keep up with the expectations. There are many things that would be easier for me with experience.”

Conversely, John B.W. Cross, who spent six years as CIO of BP Exploration and Production and five years as BP Group CIO before becoming executive vice president at Bethesda, Md.-based consultancy AppNet Inc., says that older CIOs can get “stuck in a particular mind-set, and they can be afraid of change. There’s a lot they can learn from younger executives about embracing risk and being able to say when they don’t know something.”

This being a big-tent kind of business

world, there’s room for CIOs of all ages, and even more room for the following tips, tossed from veteran to newbie, and vice versa.

The Veterans’ Views

CIOs who have been around a few years suggest the following tidbits for younger, less experienced CIOs.

◆ Don’t be a sucker.

Vendors sometimes view a young, inexperienced CIO as nothing more than a big bull’s eye for overcharging. Take nothing at face value, and double-check everything, from prices to fine print in contracts. For instance, Feucht says a telephone company vendor attempted to take advantage of

his relative lack of knowledge by charging him a rate higher than the prevailing charges in his area. He caught the attempt by running the verbals of the contract by a mentor.

◆ The bad old days were sometimes good.

Don’t dismiss the viewpoints of older IT staffers who come from the oft-maligned mainframe era. Don Heiman, who at 52 is the CIO for the state of Kansas, argues that the mainframe culture taught IT workers “tremendous discipline and attention to detail. You had to document everything and be meticulous. My main complaint with many of the younger IT folks—for instance, those coming in and working on Y2K—is that they feel that you don’t need documentation with the kind of distributed computing you have now.”



Former BP CIO John Cross advocates project management skills.

PHOTO BY MICHAEL BANE

◆ Respect your elders.

This is every bit as important in the corporate world as it was on childhood visits to great Aunt Liza. While many younger CIOs may have business-side chops, they may lack experience with executive-level meetings. Don't come in with a know-it-all attitude, advises Laraine Rodgers, 52, a former CIO who is now a vice president at Emerald Solutions Inc., an Internet consulting company in Portland, Ore. "I've seen some younger hotshots fail because they were impatient and didn't take the time to learn their way" around the corporate boardrooms, Rodgers says. Instead, soak in the corporate culture and observe how things operate at the executive level before throwing any weight around.

Justin Yaros, CIO at Los Angeles-based 20th Century Fox, took this advice a step further: He hired an executive coach when he first became CIO. He says the coach gave him useful advice on how to handle the job of CIO and how to develop a leadership agenda. He found it so helpful that he hired her to coach some of his direct reports as part of an overall leadership development program.

◆ Learn from your fellow geeks.

Build an informal advisory board of older, more experienced mentors, such as other CIOs, academics or even vendors. Often, the best way to do this is to network heavily. Cross, for example, is a devotee of industry conferences. "I always told myself that I just needed to learn at least one thing from a conference," he says. Jon Bridges, the 36-year-old CIO at Atlanta-based fast-food chain Chick-fil-A Inc., turned to an older business mentor who wasn't afraid to call Bridges on his errors. For example, his mentor stressed that Bridges' habit of "pushing things" could also be construed as pushiness, making him difficult to manage. The mentor helped him develop better change management skills and less intrusive methods of working with other senior managers.

◆ Project management skills are evergreen.

"Project management disciplines are just key," says Cross, and they can be learned only through experience. So



Physicians Health Services CIO Steve Black isn't afraid to admit ignorance.

jump right in. Rodgers advises those without significant project management expertise to not fake it: Acknowledge the lack of these skills and get involved with some big projects, posthaste. It doesn't have to be an IT project either; project management skills cross functions. For example, says Cross, "if you work for an oil company, learn about the pipelines and get involved in a technical project there." The point is to get to know the ropes because every CIO will need to know how to manage details with discipline, says Jim Sutter, a long-time CIO who spent five years as CIO at Xerox before becoming CIO at Rockwell International Corp. from 1983 to 1998. "There are so many details that can derail the CIO, and only people who have been through big systems implementations know to insist on the precision necessary," he says.

Tips from the Young Turks

Next-generation CIOs offer the following strategic suggestions to their veteran colleagues.

◆ Don't hunker down in your IT bunker.

Linda Pittinger, president and CEO of Somerset, N.J.-based People3, says that

the role of CIO has evolved from management of an isolated IS fiefdom to that of a change advocate who has influence across functions. "The new job requires an individual who thrives on constant change. In some ways, younger executives can be more comfortable with this need for reinvention," she says. It helps, says 20th Century Fox's Yaros, to toss out preconceived notions of where IT fits in the company. "CIOs should insist on equal footing."

◆ You don't have to be a kid to ask questions.

Not even Bill Gates can keep up with technology all by himself. So treat the job as a constant opportunity to learn from coworkers, no matter what position they occupy. Physicians Health Services' Black says that he disarms executives and clients "by admitting upfront that I don't know something." And that gives him the opportunity to ask all the questions he needs.

Cross says that Black's trick of lowering his guard is a tough but vital lesson for older CIOs. "You have to admit what you don't know in order to learn new ways," he says. This is especially important with new technology. "Take



Chick-fil-A CIO Jon Bridges relies on a mentor who calls him on errors.

vendor courses, whatever it takes to keep up with learning," he advises.

♦ **Toss out top-down managerial rigidity.** When Yaros became CIO, he started with a symbolic change that immediately let his staff know that the old regime was out. Yaros says he inherited an office from an "older-style CIO" that was dark and dank. "He kept his door closed and the blinds pulled," Yaros says. "The message was, 'Don't bother me.' When I had the office renovated, I had big windows put in. I keep the blinds up and the door open, and people noticed right away." Yaros followed up with regular staffwide meetings and offsite staff sessions that promote team-building and develop leaders. He's trying to make communication a two-way street, and his efforts have paid off. For example, turnover is a relatively low 10 percent—he says that other studios are reporting IT turnover of between 25 percent and 30 percent.

Black held a staffwide Q&A session

when he was first hired. The questions were submitted anonymously and he answered them live, even though there were some zingers about his lack of experience as a CIO. "Some of the questions were pretty hot," Black says. "But I addressed the misperceptions, and the fact that I did this earned respect."

"Being geeky now is cool."

—Justin Yaros, CIO, 20th Century Fox

♦ **Embrace change.**

Schneidermeyer says that, in general, younger CIOs are able to view their job as "not managing technology but as leveraging it to improve business processes. It just seems that younger CIOs have gotten that message sooner because they don't have the baggage of previous technology eras."

For example, Yaros says that one of his goals at Fox was to overcome a view

of the IT department as stodgy and out of touch. Yaros says, for example, that one of his first acts as CIO was to meet with top business executives to discuss their priorities and technology wish lists. In fact, one such executive told Yaros that this was the first time an IS executive had ever asked his opinion. By listening rather than dismissing new proposals, "I struck them as more willing to accept new ideas and to be more adaptable to change," he says. "I didn't appear premolded to these business execs."

♦ **Find ways to relate to your younger staff.**

The business world has changed vastly in the past 10 years alone, and many newer people have little patience for traditional corporate mores. Nowadays, CIOs need to do a little reaching out. Bridges, for example, believes that inspiring team building can happen through outside activities. For instance, he, along with a few other IT staffers, took an unpaid day off recently to help another employee paint her house. And the entire department is planning a horseback riding jaunt this year.

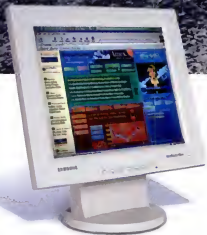
This may be a little too chummy for some CIOs, and trying to fake such intimacy may show. But Cross says that each CIO must find his or her own way to get closer to staff. "You can take a real personal interest in a project rather than having a hands-off management style—you can roll your sleeves up and show you feel their pain," Cross says. But CIOs must get involved with their workers in order to build a team out of an aggregate assortment of people.

As Yaros says, "being geeky now is cool." And right now there are plenty of jobs for CIOs of all ages—but don't make the mistake of sitting back and getting too comfortable. "I think this is the most exciting time in 20 years to be a CIO," says Sutter. "But it's important, too, for CIOs to force themselves to challenge the way they have been doing things and make sure they are current. If they think they are too busy to do that, they will lose." **CTO**

Senior Writer Mindy Blodgett can be reached at mblodgett@cio.com. Senior Writer Polly Schneider contributed to this article.

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JACKSON JONES SITS AT HIS COMPUTER, tapping away at the keys. Jackson is happy and productive; life is good. Suddenly a shadow passes over the monitor and two strong arms lift him from behind. Jackson protests, but the only tools available to him are fussy faces and two small waving hands. He gives up. No matter how technically proficient you may be, when you haven't yet hit your second birthday you still have to defer to Mom over naptime and apple juice.

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- ◆ How schools are integrating technology at the K-12 level
- ◆ How learning styles and habits change with technological evolution
- ◆ How to prepare for your future workforce

members of what Don Tapscott, in his 1997 book *Growing Up Digital: The Rise of the Net Generation* (McGraw-Hill), labels the Net Generation. Today's school-age children, growing up in an educational landscape where technology access is paramount, are poised to march into the new millennium with laptop in tow and computer knowledge firmly ensconced in their little heads. And over the next couple of decades, sometimes with baby steps and other times with giant leaps, they'll start changing the workforce.

Some of them—kids who have never known a world without computers, students who have never written a letter by hand—will be the IS employees of the future. Some will be your internal customers, and others will be external consumers of your company's products. But they will all, in one way or another, affect the way companies do business. And while the changing nature of the CIO position makes it impossible to predict where today's technology executives will be tomorrow, the workforce is fluid enough that those who grew up with computers will soon meet those who didn't. People, get ready.

Like I Don't Have Enough to Worry About

To prepare for your future colleagues and customers, first consider where they're coming from. Thirtysomethings and fortysomethings might remember learning to assimilate the Internet into their jobs as it evolved, just as twentysomethings assimilated it into their college environments. But young students in school now might not think it outlandish to ask, "What do you mean, there hasn't always been e-mail?"

"Most of these kids have never wound

BY MEG MITCHELL

the past
decoding
the future
INVENTING THE FUTURE

a watch, touched a typewriter, seen a record album," says Willard R. Daggett, president of the Rexford, N.Y.-based International Center for Leadership in Education, which is dedicated to making school curricula relevant to an information-based society.

"To young children, technology is not the Internet and floppy disks," he says. That's just the background hum of history. For them as for most of us, Daggett says, "Technology is anything created since you were born." When children breathe in computers and the Internet even as they learn to walk and talk, a tricky issue arises for educators and businesspeople alike. Today's school-age generation is the first to include large numbers of kids who hop off the school bus knowing more about technology than do their teachers. Not only does that turn the whole notion of teacher as disseminator of knowledge on its head, it has implications that reach beyond the classroom and into the office park. In the old scenario, the teacher was the boss. "In the new scenario, the teacher becomes the facilitator," says Daggett. For the most part, teachers who use technology in the classroom no longer funnel information into their students' heads: Where teachers of yesteryear might have taught fifth-graders facts about ancient Egypt from textbooks, today they are more likely to send them to the Web to take a virtual tour of the pyramids or play an interactive game with hieroglyphics.

"It's no longer that sage on the stage but the guide on the side," says Mike Maternaghan, business development manager for British Telecom North America (BT) and a psychologist who has studied the harmonization of people and technology. And that evolution will probably apply to other authority figures in these students' futures—that is, their bosses.

As a teacher's role changes, so do the methods of teaching—and the results.

Willard R. Daggett, president of the International Center for Leadership in Education, believes technology in teaching changes old power structures.

Not everyone thinks introducing young children to computers early on is the right thing to do (see "Not So Fast," Page 161), but nonetheless a slew of educational software and online child-oriented activities is making learning

puzzles and participate in virtual classes. An interactive reference area means that kids can search an online encyclopedia while they're engaged in one of the online activities; a fax alert lets them know what other kids are buying

even as they're communicating with one another. "Younger kids get bored if they're doing only one function at one time," explains Alan Rothenberg, JuniorNet's founder and

CEO. As software and schools begin to cater to the short attention spans and the take-it-all-in-at-once attitude of today's kids, businesses would be smart to prepare.

A peek inside JuniorNet's downtown Boston offices, where the average age of employees is 23, shows some of that youthful need for multiple stimuli already gripping the workplace. Of course

“The scariest thing about the future is if computers broke down.”

—David G., age 10

speedier, flashier and less traditional than ever—and making the teacher less central to the learning process. Consider JuniorNet Corp., an online service for kids ages 3 to 12 that has teamed up with children's publishing giants like *Highlights for Children* and *Sports Illustrated for Kids* to produce an advertising-free place where young members can perform interactive research, do

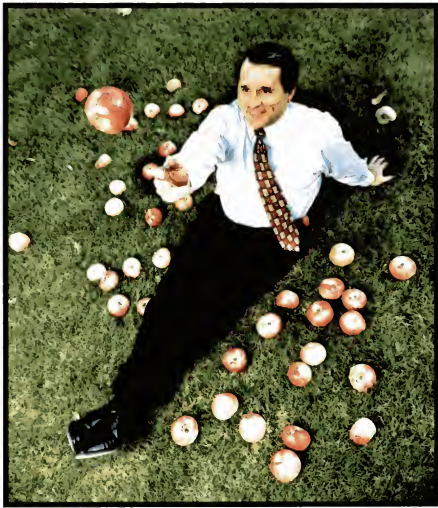


PHOTO BY BENJAMIN GRAY

societal changes don't happen in the blink of an eye, so it's impossible to pick one day in the future and say that's when the workforce will change. But it's fair to say that the youngest workers out there now represent the breaking edge of the new wave of employees. At JuniorNet, programmers watch their computer screens, listen to music through headphones and carry on conversations all at once, thriving on what may be distractions for older workers. When the first set of cubicles went into the offices, employees thought the walls were too high; they wanted to be able to see what their coworkers were doing. The spirit borne of the collaborative nature of information technology—whether it comes from kids clustered around shared computers in the classroom or virtually clustered in an Internet chat room—infuses the entire office.

A digital diet certainly produces a different worker, and some may argue that it's not necessarily a better worker.

"Production is great, but individuality is sacrificed," notes Rothenberg, who speaks not only as a businessman but as a father of three who is watching his children grow up in a world governed by technology. He's not sure he's ever seen his daughter hand write a letter, and his children seem to look for verbal hyperlinks when he talks to them—"yeah, Dad, I *know* that; click to the next part." But as technology access in homes and schools increases, children who think this way will be as common as freckles in Ireland.

No More Pencils, Hardly Any Books

While a technically saturated childhood doesn't guarantee a better employee or citizen, it's not stopping many schools from taking a leap onto the technology bandwagon. "You talk to any superintendent nowadays and they can talk about their LANs, their high-speed WANs, T1s, ATMs. They can talk to

you about wireless and what they should be doing with wireless, because everyone is convinced that technology will make a difference in education," says Bill Rodrigues, vice president for K-12 education at Dell Computer Corp. in Round Rock, Texas. His division works with schools across the country to help build technology infrastructures.

At Western Heights School District in Southwest Oklahoma City, which works with Dell, a combination of E-Rate funding (part of the \$2.5 billion allotted to schools and libraries through the Federal Telecommunications Act of 1996), bond initiatives and funding from local businesses has helped create one of the most wired districts in the country. In 1995 the Oklahoma Board of Education requested the district study how proficient its schools were with technology. The results: The district was woefully unprepared to help students meet a technological future. So a task force of 24 educators developed a plan

Not So Fast

Too much technology too soon may do more harm than good

Not everyone thinks that early exposure to technology means better students and more avid learners. Jane Healy, educational psychologist, author and lecturer, spent years observing classrooms and interviewing teachers, parents and cognitive experts for *Failure to Connect* (Touchstone Books, 1999). What she found might make some parents rethink that pint-size computer desk. The business of the future, Healy contends, doesn't need just the technology savvy. In fact, those who learn technology at the expense of other skills may be hurting themselves and the world they are preparing to enter. "[Businesses] need people who are creative and adaptable and have good minds to figure out new solutions to new problems," Healy says. And she thinks the increasing use of computers in the classroom may be keeping that from happening.

"I'm very concerned that the emphasis on marketing computer literacy to very young children is missing the point of what is really going to prepare these children to contribute effectively to the business of the future," Healy says.

Where do the dangers lie? Healy posits that many early childhood software programs are training children to be droids by teaching them routines and formulas rather than creative problem-solving abilities. So while computers may have their place in the classroom and, when used correctly, can act as valuable learning tools, too much too soon can stunt physical and creative growth.

And this isn't a problem for just schools and parents—Healy warns that if businesses don't get involved early and often in the educational landscape, they will have a paltry group to choose from when it comes time to hire the next wave of workers.

The solution? Hold off computer exposure until after age 7—a shift in the brain at that age makes the abstract world much more accessible. And businesses should articulate the nontechnology skills they'll need in the future to make sure the schools deliver them. "Businesses can provide a model of saying, We want people who can think, create, reflect and imagine," Healy says.

—M. Mitchell

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to improve the district's technology access. Five years ago, the district had only two small, unconnected networks, and an Apple IIe was the only computer in classrooms that were lucky enough to have anything at all. Today, fiber-optic cabling connects the four elementary schools, high school, middle school and an alternative education site. Each teacher's workstation has videoconferencing capability, every student and teacher has an e-mail address, and for the last four years the school has been building a network so advanced and user-friendly it would make some CIOs drool onto their keyboards.

Observers might be surprised to learn that Western Heights doesn't have pots of its own money to throw at technology; in fact, 72 percent of the district's students qualify for free or reduced-rate lunches. Joe Kitchens, superintendent of schools for Western Heights, acknowledges that securing funding is one of the toughest parts of wiring the district. He has found, however, that businesses are more than willing to pitch in and that E-Rate dollars, courtesy of a presidential administration committed to improving technology access in schools, can go a long way.

Kitchens claims technology will allow the school to expand and be more flexible in the services it offers to students and the school community, even to the point of being a 24-hour organization. He cites the case of a teacher who was being treated for cancer; the district sprung for a computer for her home that allowed her to continue to communicate with students during her recovery. And he emphasizes that technology is the key to letting students learn at different paces, allowing accelerated students to take distance-learning classes that their own schools may not offer. Kitchens' district recognized early the dominant role technology would have and wasted no time making sure its students would be prepared to meet the challenges of an information economy. The question then becomes whether the businesses are ready to meet the students.

The Developing Workforce

While Western Heights' commitment to technology may be ahead of other districts of the same size and economic sit-



Alan Rothenberg, founder and CEO of JuniorNet Corp., observes that tech-savvy children appear to think in hyperlinks.

uation today, it won't be long before its approach is the rule rather than the exception. The demand is for more and more IT resources, and the mantra is, "If we don't integrate technology we'll fall behind." For the short term this may mean a scramble for schools and districts to secure the funding and the human capital to get their schools running at the speed of business (see "Teach the Teachers Well," Page 166). But in the long term it means that more and more students, for better or worse, will leave school with the indelible print of technology on their brains.

Karen Krupnick, a 28-year teaching veteran at Gerald Litel Elementary School in Chino Hills, Calif., says most of her students have computers at home, and their comfort level with technology is extremely high. "Their toys are all

computerized, they know the ins and outs of computers and use them regularly for all kinds of purposes, and unlike adults, they are not surprised by much new technology. They simply integrate it into their lives." That's a crucial difference between generations that will force CIOs and vendors alike to rethink the way they deliver technology solutions (or any other product) to both internal and external customers—as these kids grow up, they'll focus on what technology can do for them, not just the bells and whistles that come along with it.

This is not to say that the CIO who plans to be around in the next couple of decades should run for the hills, with visions of robot children running through her head. But CIOs should be aware that the results of technology's



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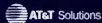
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proliferation in K-12 education will greet them in three different guises: internal IS workers, users within the company and external consumers of a company's product. The CIO who wants to meet the future with a smile rather than gnashing teeth must look at each in its own way.

What Does This Mean for Me?

To work with the IS department of the future, keep in mind that the teacher-as-facilitator role will continue to spill out into the workplace; these kids will want

and expect to collaborate with their bosses, not take orders from them—even more than today's workers do.

At Glen Cove Schools on Long Island, Superintendent Frank DeLuca agrees. He sees a future where teachers become "the originator of the project, defining where students should wind up and allowing them to get there on their own." Fast forward a few years and what do you get? Employees who bring that attitude into their work life.

From internal users, CIOs should expect higher demands for the best technology and tailored applications. To Dell's Rodrigues the key is not just that today's students will be ready to use the technology but that they'll be in a position to ask for it. At Dell, for example, a technology-rich environment means that employees can attend training classes at Dell University; they can also find out almost anything they need to know about the company from Dell's intranet. Expect expectations like those to increase. It won't be too long before the CIO's responsibilities include making technology resources throughout the company appealing enough to attract employees of every kind into departments like HR and finance. It doesn't take a rocket scientist to figure out that a job-seeker who enjoyed top-notch technology from first grade on will disdain a company that offers slow network connections and old machines. "The CIO has to be able to provide everyone with useful, ubiquitous computing," says BT's Maternagham.

James Schmidt, senior vice president for the technology services division at First National Bank of Omaha in Nebraska, offers a slightly different take on what the workforce of the future will require. "Today we incent people to get into the new stuff," he explains. "I think the time will come when we'll have to incent them to stay on the old stuff." Technology isn't implemented as quickly as it's invented, and older skill sets will still be in demand to keep IS departments running smoothly.

Organizations should also get ready for a new wave of consumers who have grown up with blinking advertisements and the promises of speed and consumer choice all around them. "You're finding a whole generation of children that's

Teach the Teachers Well

Learning with technology has to start by educating the educators

Fully stocked computer labs monitored by people uncomfortable with the technology are about as beneficial as a luxury sports car sitting outside a house where nobody has a driver's license.

A recent report from Shelton, Conn.-based Market Data Retrieval (MDR) suggests that America's teachers are not yet comfortable enough with technology to integrate it fully into the classroom. The report polled 1,547 teachers at the elementary and secondary levels. Sixty-seven percent of the teachers reported that they were not required to demonstrate technology proficiency to get their teaching certificates. Less than 40 percent reported receiving one to five hours of technology training in past 12 months, and 23 percent have received no official training at all.

Why the problems? For one thing, teachers, saddled with enormous amounts of work and often underpaid, don't always have the energy to explore an entirely new field.

"Teachers are inundated with a constant flow of new ideas, many of which are trendy and will no longer be used in two years," says Karen Krupnick, who teaches a fourth-grade gifted class at Gerald Litel Elementary School in Chino Hills, Calif. "They want assur-

ance that technology won't be one of [those passing trends]."

Kurt Reister, a kindergarten teacher at Raleigh Park Elementary School in Portland, Ore., agrees. "I've taught two years now, and I've been quite amazed at how much we are expected or required to fit into our curriculum and assessments, without additional assistance, time or compensation. You can imagine how 20-year veterans feel."

And there's a fine line between knowing technology and knowing how to teach with technology—computers in the hands of someone who values bells and whistles over learning can be a weapon rather than a tool.

But things may be looking up. MDR's report says that 62.5 percent of teachers between ages 20 and 29 feel very comfortable using e-mail, whereas only 46.9 in the 40-to-49 age group are comfortable. So if new teachers continue to enter the workforce with high-tech exposure in their histories, schools can expect better uses of computers in the classroom.

"It is important [that teachers] do not feel forced to use the technology but that they see it as a wonderful addition to their teaching experience," explains Krupnick. "We are no longer in a little red schoolhouse; we are part of a greater picture." —M. Mitchell



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growing up with technology, and [they use it to] communicate, collaborate, buy things," says Rodrigues. As the first generation to grow up with online shopping, kids today know that for every Amazon.com there's a Barnesandnoble.com and that if they can't find something one place quickly, another company will certainly be happy to supply it.

Furthermore, Janneke Bogyo, a teacher on the Tuscarora Reservation in Western New York, says students now realize that they can't believe everything they see. Learning to separate the wheat from the chaff on the Web makes them more critical. "It's not like the old days when you opened the World Book and it was the word of God," she says. This should make for more discerning consumers and a push for better products. And that'll offer up a challenge to manufacturers and advertisers alike.

Mike Maternaghan, business development manager for British Telecom North America, says, "It's tempting to say that if you can't use a computer in a couple of years it will be like not being able to read."

In the workplace, these trends will take shape as interesting new demands on management. "Most of the knowledge workers at any organization are technology savvy and they are demanding access to information," says Satish Ajmani, CIO for the county of Santa Clara in California. Ajmani thinks that

"The technologist's job is going to be to make sure that infrastructure is there," he says.

It's All Good—or Is It?

For every story of an underprivileged kid who learned how to use a computer, there's a frustrated teacher without the

time to learn the technology or a lower-middle-class kid who's falling through the cracks. And for every request for more and better computers

there's a school or district budget sinking deeper into the red. But these considerations aside, there are social implications that go along with introducing kids to technology when they're young. Some argue that children who have early access to vastly more information than their elders did are growing up too fast. In addition, in a world where day and night access to school is becoming as prevalent as 24/7 access to work, free

time is dying a rapid death.

How that dwindling commodity is spent is also changing. Rothenberg tells the story of a fiftysomething employee at JuniorNet who suggested putting together a company softball team. Nobody was interested. Instead employees play computer games with companies in nearby office buildings—both their uptime and downtime involve a monitor and a mouse.

But for good or bad, technology has captured a starring role in America's schools. Kids in school today have a Web search for breakfast, e-mail for lunch and videoconferencing for dinner. It won't be too long before these kids will want to work for you or your company or buy something from your Web site. And if you're not ready to serve them in whatever capacity they demand, it's very likely your competitor will be. **ECO**

“In the future we will be able to make telephone calls to the different planets the same as we

make calls between states.”

—Chris M., age 11

workstation support, heretofore the domain of the CIO, will cease to be of major importance in the future. "The challenge we're going to face is satisfying the demand for information that the knowledge workers need to do their jobs." One important shift he has noted in his organization: CIOs have to set up information so that it easily answers business questions, and in the future that need will only increase.



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Measures That Matter

So long, bottom line. Today, performance indicators must do more than just measure profits and losses. Swedish expert Eric Giertz explains.

BY POLLY SCHNEIDER

THINGS WERE SO SIMPLE IN the industrial days: Companies could hum along profitably for years if executives merely kept a close eye on the bottom line. Those operating in the black were considered successful; those in the red were not. Of course, those days are long over. In the Internet age, disintermediation forces, consolidation and global competition are forcing executives to pay closer attention to softer stats like quality of service, customer retention and satisfaction, and employee loyalty.

In today's service and knowledge economy, performance metrics must take into account the changing definition of success (customer experience, not just price and product differentiation, for one), and they must make sense to the individual worker, according to Swedish researcher, professor and business consultant Eric Giertz. Broad financial measures such as profit and loss do not give employees much information on how to improve in their daily jobs. "If you choose the right performance measures, each employee should know

when they leave the job every day if they have done well," he says. And that's good for business, since employees are the ones dealing with your customers, day in and day out.

In his forthcoming book, *Measuring Success: Identifying Performance Indicators* (Celemi Publishing Inc., spring 2000), Giertz defines various business functions (or "logics," as he calls them) within the enterprise that can be used to identify performance measures to apply to each individual business unit or department. Some companies have only one business function with corresponding measures (a consultancy, for instance), while a consumer goods company that develops, produces and markets its products encompasses several areas.

In this light, the factory at Squeaky-Kleen, a fictitious soap company, probably shares more similarities with a flour mill than with any other division of SqueakyKleen. Using the Giertz model, both operations fall under the "labor-intensive processing plant" logic, where the most important measures include inventory turnover rates, volume produced per employee and percentage of late deliveries—all of which contribute to the overall profitability of the company. If a warehouse worker knows how much mineral oil is the optimal amount to stock for a given quarter of soap production, has the software tools to track that, and understands what it means for the company and her next raise if the goals are met, chances are she'll work hard to meet and exceed those expectations.

Beyond making measures more meaningful for employees is the challenge of selecting those critical indicators that will propel an organization to industry leadership. Quips Giertz: "If it's good all the time, we don't have to measure it."

CIO recently spoke by phone with Giertz at his office in Stockholm, Sweden.



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CIO: Why are financial measures becoming less important than intangibles like customer satisfaction?

Giertz: The financials are still important to some people, like managing directors, but individual workers cannot understand how to improve their operations just by looking at financial ratios. They can't connect their work to these numbers. In retailing it would be more helpful to look at things like average purchase per customer.

If you really want to improve the processes, you have to involve management and employees in the discussion. Then you shouldn't try to compare different units but look at how you can manage each unit to improve its business. Too many people want to take the easy way and say there is only one set of indicators for measuring every kind of operation all over the world. If that's the approach you take, then you will fail.

How would these new indicators work at, say, an auto manufacturer?

Giertz: That kind of company consists of several different business logics. For instance, you have capital-intensive processing—machines that work 24 hours a day, seven days a week, making single parts within the motor. In that kind of

total time. You should also try to understand customer satisfaction through questionnaires. Then you should conduct spot checks to see if the jobs that you charged the customer really got done. You may get some kind of objective quality index indicating that you have a lot of recalls for jobs that are not well

done. Or, let's say there's a lot of wasted supplies—4.8 percent, for instance. To get it down to less than 1.8 percent, you can measure it each day for six months. When you have reached the goal,

let it go for a while. If it gets terrible again, bring it back as a performance measure. So you can use recall job ratio, quality index, customer attitudes, capacity utilization and labor productivity as performance measures. If you perform well on all five, probably you will have great revenues, customer return, high productivity and efficiency.

When looking at the numbers, you

"Each year you should reconsider whether you're looking at the most important measures and, if not, change them."

operation you'd need to measure equipment availability and production quality. Then you have people assembling cars, which is where labor productivity is a priority—so you'd look at the number of cars assembled per month.

In the repair shop at the dealer, you must look not only at the time it takes to perform a service but also how to classify the time, such as billable time versus

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should know what is the average that you have met before, what is the lowest, the worst case and the best case. Then you should know how much this fluctuates and what should be the bottom-line situation for each day or each week. Finally, each year you should reconsider whether you're looking at the most important measures and, if not, change them.

What role does IT play?

Giertz: It varies. A manager in a retail store could ask her employees to promote certain products or offers that will entice customers to buy a little more, with a goal of increasing the average sale of \$40 to \$46. Of course, to measure how much the average customer is buying each day, you need information technology. Sometimes IT actually plays a bad part because financial controllers bring out lots of different statistics that you don't know how to use and may not be of great importance to your employees. So you should first ask how do you want them to perform, how can you

measure it, and is IT available? Today it's sometimes the other way around. IT makes a lot of information available, and you almost drown in it—you can't see what's important anymore.

What kind of results have you seen in Sweden from using this kind of performance measurement system?

Giertz: I have been working with manufacturing companies to see how people on the factory floor involve themselves in productivity improvements. They do things that people in engineering or product development have never thought of because they don't know the operation well enough. In one print shop, the value added per employee increased by more than 20 percent when they began tracking indicators like delivery precision, paper waste and capacity utilization.

So we're talking major improvements in process and revenues?

Giertz: Major improvements due to lots of small, continuous improvements. If you manage each kind of operation

uniquely within the organization, you will get quite good at delivering a particular service. Ultimately, diversified conglomerates will be reduced in number and will instead leave way for big, global, very specialized companies. And that means knowing how to replicate and to run a specialized business in many local places will be important management skills.

Is this trend good for the consumer?

Giertz: There are major efficiency and quality advantages in providing services in large volumes. Companies will never be able to rest on their laurels because there will always be competition. If you don't change your standards, you will lose market share. It's the same mistake Henry Ford made when he said the Model T was the final car. It turned out that there was further development of cars. In the end, the consumers have the power. 

Senior Writer Polly Schneider can be reached at pschneider@cio.com.

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BY HOWARD BALDWIN ♦

TO REMEMBER

THESE ARE THE DAYS

WAR DOES FUNNY THINGS SOMETIMES. TODAY, WE have the Internet—a redundant network of independent computers—because the federal government wanted to ensure communications even if one particular computer was wiped out by an atomic bomb. It started as the ARPAnet, a Department of Defense project, and today it's bolstering the global economy as never before. And since countries tend not to bomb their trading partners, this offshoot of war is a big contributor to peace.

The dawn of the Internet seemed a good place then to start a time line of three of the most amazing decades the world has ever seen.

...1969

1969 The Internet boasts four hosts: UCLA, Stanford Research Institute, the University of California at Santa Barbara and the University of Utah. When a UCLA researcher tries to log in to SRI, the system crashes on the third keystroke.

1969 At AT&T Bell Laboratories, Ken Thompson and Dennis Ritchie create a multiuser operating system to run on a DEC PDP-7 mini-computer and dub it Unix.

1971

1971 Microelectronics News Editor Don Hoeller coins the name Silicon Valley.

1970

1970 Xerox Corp. creates the Palo Alto Research Center (PARC), based on the precept that people didn't need to understand how the innards worked to use the technology. Over the next 10 years, PARC researchers come up

1972

1972 Intel introduces the 8008 microprocessor; it was initially used in a dumb terminal.

1972 Hewlett-Packard Co. makes the slide rule obsolete with the introduction of the HP-35 calculator.

1972 Nolan Bushnell installs the first working version of the Pong game in a Sunnyvale, Calif., bar. Horrified by a report that the machine is broken, Bushnell hurries over to discover that it's actually too jammed with quarters to accept any more.

1972 Bill Gates establishes his first company, Traf-O-Data, whose software monitors highway traffic flow.

with bitmapped displays, icons, cursors, laser printers, Ethernet and the first PCs. None is successfully marketed by Xerox.

1970. Honeywell Inc. takes over General Electric's computer operations.

1970. IBM researcher Edgar Codd develops the relational database.

1977. Steve Jobs and Steve Wozniak establish **Apple Computer Inc.**, reportedly because they wanted an Altair but couldn't afford one.

1977. At the Convention of the World Future Society in Boston, DEC President Ken Olsen declares, "There is no reason for any individual to have a computer in their home." (Eleven years later, Olsen will slam Unix as "snake oil.")

1978. Texas Instruments Inc. introduces Speak 'n' Spell, a teaching toy incorporating digital speech.

1973. Bob Metcalfe invents Ethernet networking.

1973. IBM introduces Winchester **disk drives**, which set the standard for storage for the coming decade by featuring two spindles with a storage capacity of 30 million characters each. (The nickname derives from the Winchester rifle's .30-caliber shells.)

1980. Microsoft announces Xenix OS, a derivative of Unix designed to run on computers using Intel 8086, Zilog Z8000 and Motorola 68000 processors, as well as DEC's PDP-11 minicomputers. In 1989, Microsoft will buy approximately 20 percent of The Santa Cruz Operation, a developer of **Unix for PCs** (Microsoft still holds this stake).

1981 IBM debuts its first PC, revolutionary because it's made from off-the-shelf parts and its specifications are made public.

1981 Osborne Computer introduces the Osborne 1, the first portable computer. It weighs 23.5 pounds, measures 20 1/2 by 13 by 9 inches and offers 64KB of memory.

1974. **Digital Equipment Corp.** (DEC) enters the Fortune 500.

1975. Micro Instrumentation and Telemetry Systems (MITS) of Albuquerque, N.M., offers the Altair, the first personal computer available for purchase. It's named after a planet in the *Star Trek* episode, "A Voyage to Altair." It inspires Bill Gates to write a version of Basic for it, even though it has no monitor, no keyboard and no storage capabilities.

1975. **Bill Gates and Paul Allen** establish **Micro-soft**, dropping the hyphen in 1976 when they register the trade name with the Office of the Secretary of State of New Mexico.

1976. Tandem Computers Inc. introduces the first fault-tolerant computer.

1982. **Compaq Computer Corp.** is founded, and four years later reaches the Fortune 500, faster than any company in history.

1982. *National Geographic* spotlights Silicon Valley, noting, "At \$24,000 a year, per-family income ranks among the highest in the nation, yet roof-raising real estate prices make affordable housing scarce." By 1995, per-family income had doubled to \$53,490 and affordable housing was even scarcer.

1982. Sun Microsystems Inc. is founded, its name an acronym for Stanford University Network.

1979. VisiCalc, the first electronic spreadsheet software, is demonstrated at the West Coast Computer Faire. Four years later, Lotus 1-2-3 completely dominates the spreadsheet market, only to be surpassed itself after Microsoft Corp. introduces Excel in 1987.

1979. Micropro International introduces WordStar, one of the earliest word processing software packages. Five years later, WordPerfect's eponymous word processing completely dominates the market, only to be surpassed itself after Microsoft introduces **Word for Windows** in 1989.

1983. Time magazine names the computer **Machine of the Year**. The issue identifies five people in the "vanguard of the revolution": IBM CEO John Opel, Osborne Computer President Adam Osborne, VisiCalc inventor Dan Bricklin, Commodore International President Jack Tramiel, and Clive Sinclair, developer of the Timex Sinclair ZX80.

1984. Apple Computer introduces the Macintosh with a commercial comparing IBM to Big Brother that's broadcast only once during the Super Bowl.

1984. On Feb. 13, *Computerworld* publishes "The Problem You May Not Know You Have," an article by Paul Gillin warning IT staffers about the millennium bug.

1984. Hewlett-Packard introduces the first commercial laser printer.

1984. Esther Dyson coins the term **vaporware** to describe software that's announced but not released.

1984. Len Bosack and Sandy Lerner, two married academicians at Stanford University, discover that because they're on separate networks, they can't communicate with each other. In frustration, they start working on **ideas for internet-working** and later in the year found Cisco Systems Inc. Now divorced and departed from the company, their names are absent from the company's Web site.

1983. 50,000 people turn out in San Francisco for a trade show covering the CP/M operating system, as many as had attended the previous fall's Comdex.

1986. Burroughs merges with Sperry to form Unisys ("the power of two").

1986. Will Zachmann, an analyst for International Data Corp. (IDC, a sister company to CIO Communications Inc.), coins the word *downsizing* as a term for moving from mainframes to smaller systems; the term is later co-opted as a synonym for layoffs.

1985. Computer Intelligence Corp. reports that 53 percent of all installations with both mainframes and PCs either already have links between the two or soon plan to implement them.

1985. *Software* magazine designates its top 10 software companies: Cullinet, Lotus Development Corp., Microsoft, Management Science America Inc., Applied Data Research Inc., Computer Associates, Informatics, Dun & Bradstreet Software, Uccel and Ashton-Tate. (By 1990, five of these had been acquired; today, only Microsoft and Computer Associates are independent companies.)

1985. The proprietary word processing systems of Wang can be found in 80 percent of the nation's 2,000 largest companies. Company leaders misjudge the shift to open systems and PCs, though, and in 1992 the company declares bankruptcy (it is now part of an Amsterdam-based IT systems integration firm Getronics).

1988. CIO magazine is founded.

1988. A Cornell student named Robert Morris writes a virus called a "worm" that brings the Internet to a standstill. At his trial, Morris is sentenced to three years' probation, assessed a \$10,000 fine and ordered to perform 400 hours of community service.

1988. AT&T, which owns the Unix operating system, acquires 20 percent of Sun Microsystems. Worried that this ownership will give Sun's machines an advantage, HP, DEC, IBM and others form a standards body called The Archer Group (later named Unix International) to maintain the Unix standard. These moves presage years of standards wars.

1988. Microsoft President Jon Shirley predicts that OS/2, then jointly produced by Microsoft and IBM, will run on 80 percent of desktop PCs by 1991.

1987. IBM announces SAA (systems applications architecture) on the mainframe side, and the PS/2 computer, the OS/2 operating system and the microchannel architecture on the micro-computer side.

1987. The first *Computer Industry Almanac* predicts that by 2000, the electronics industry will be a \$900 billion-a-year business, second only to agriculture in the world economy.

1991. Go Corp. debuts PenPoint, an operating system for pen-based computers. Four years after the company's founding, the disastrous venture will later be chronicled in *Startup: A Silicon Valley Adventure*, a book penned by CEO Jerry Kaplan.

1991. The Federal Trade Commission begins to investigate Microsoft.

1991. IBM and Apple ink a historic deal that includes the creation of two joint ventures:

Taligent, to develop an advanced **object-oriented operating system**, and **Kaleida**, to develop multimedia products. The operating system strategy is targeted at Windows 3.0, which sold 100,000 copies in two weeks upon its 1990 introduction; and eventually crushed both IBM's OS/2 and Apple's MacOS. Neither venture is a success, and both are shut down by 1995.

1990. In February, *Business Week* publishes an article entitled "CIO Is Starting to Stand for 'Career Is Over.'"

1990. Lotus introduces Notes.

1990. Lotus and Novell Inc. announce intentions to merge, but talks break off over how to divvy up seats on the board.

1990. IDC predicts that the Macintosh-to-mainframe market will grow at an annual

rate of 56.8 percent over the coming five years.

1990. IBM first uses the term *legacy systems* to describe systems that present a conversion, maintenance or upgrade challenge.

1990. NCR abandons its proprietary mainframe line to concentrate on systems built with single or multiple Intel processors; a year later, it will be swallowed by AT&T, and then in 1996 spit back out again.

1990. Intel announces a parallel supercomputer using more than 500 1860 RISC processors. By 1996, Intel will abandon its supercomputer efforts.

1989. After Morino Associates and Duquesne Systems merge, they christen the new company Legent Systems Corp.

1989. Dun & Bradstreet Software, which had acquired McCormack & Dodge in 1983, buys M&D's biggest rival, Management Science America.

1989. IBM releases its first SAA application, OfficeVision.

1989. HP, Data General and Prime establish the Object Management Group to standardize the creation of software for object-oriented programming.

1993. John Akers resigns as chairman of IBM; Lou Gerstner becomes CEO.

1992. After DEC's net income drops \$1.1 billion in 1989 to a \$2.8 billion loss in 1992, founder Ken Olsen resigns from DEC after 25 years.

1993. Cisco Systems buys Crescendo Communications, an FDDI networking company, the first of some 33 acquisitions the company will make in the next six years.

1993. Microsoft announces the Microsoft at Work initiative, which will tie traditional office machines like photocopiers in with computers; it becomes one of Microsoft's few failed initiatives.

1993. Judge Vaughn R. Walker rules against Apple

Apple in its famous "look and feel" lawsuit against Microsoft and HP, in which Apple claimed that its method of displaying graphical data using overlapping windows had been copied.

1993. Microsoft announces Windows NT, which originally began life at least two years earlier as "portable OS/2" and was initially planned for release in 1992. Bill Gates promises 1 million licenses will be sold, but after 12 months the number is estimated at only 600,000.

1997. In a stock swap worth \$3 billion, Compaq acquires Tandem.

1997. In a record-setting merger, upstart telecom firm Worldcom buys MCI for \$36.5 billion.

1997. A year after Larry Ellison unveiled the idea, network computers arrive on the market with a dull thud, doomed by confusion between NCs, NetPCs and Windows-based terminals.

1997. Dell Computer Corp. sells \$1 billion worth of computers through its Web site, just 18 months after it turned to the Internet as a sales channel.

1994. In an unsuccessful effort to compete with Microsoft in the applications market, Novell buys WordPerfect and Borland Corp.'s QuattroPro spreadsheet; Microsoft Office soon consolidates its hold on the productivity software, and Novell sells what's known as WordPerfect Office to Corel Corp. in 1996.

1994. Network hardware vendors Wellfleet (based in Massachusetts) and SynOptics (based in California) agree to merge to form a company called Bay Networks; bicoastal cultural issues flare until it's acquired by Ontario-based Northern Telecom, with the resulting firm called Nortel Networks.

1994. Playboy interviews Bill Gates, who describes (among other things) a wallet PC as a small, portable PC of the future—"say about five years from now."

1995. There are now 5.8 million Web hosts.

1995. The summer sees the beginning of two Internet e-commerce pioneers: In July, Jeff Bezos launches Amazon.com to transform book buying; in September, Pierre Omidyar launches eBay.com at the suggestion of his wife, an avid collector of Pez dispensers.

1996. Web addresses start appearing in advertising campaigns; the first may be GT Interactive, which uses its URL on marketing material for its CD-ROM games.

1996. In the largest IPO until that time,

AT&T spins off its hardware division, Lucent Technologies, for \$3 billion.

1996. Baby Bells converge again, with SBC Communications Inc. acquiring Pacific Telesis Group (and then Ameritech Corp. in 1998) and Bell Atlantic Corp. merging with Nynex.

1996. Hewlett-Packard cofounder David Packard dies; on the advice of Stanford engineering professor Frederick Terman, he and William Hewlett had established

their company to take advantage of local graduates, laying the seeds for today's Silicon Valley.

there are now 56,218,000 Internet hosts.

1999. The First Internet Bank of Indiana, the first full-service Internet-only bank, goes online.

1999. Hewlett-Packard decides to split the company in two—the computer division, for which the company is best known, and the instrumentation division, on which the company was originally founded (HP's first customer was Walt Disney, for whom they built an oscilloscope that was used in the 1940 production of *Fantasia*).

Former Senior Editor Howard Baldwin extends his thanks to Ed Bride, formerly of Software magazine; the Computer Industry Almanac; IBM Corp.; and IDC for their assistance.

1995. Just a year old, Netscape goes public on Aug. 9 at \$28 a share, shoots up to \$75 and closes the day at \$58.25. Three years later, it's acquired by America Online Inc. for \$4.2 billion.

1995. Sun Microsystems announces Java, a lightweight operating system originally designed by James Gosling to run on cable set-top boxes. Before long, programmers discover its value as a platform-independent development environment.

1998. Compaq buys DEC for \$4.5 billion, the largest acquisition in the computer industry.

1998. In the first six months of the year, Web-related mergers total \$1.5 billion. In the first eight months of the year, 23 Internet companies raise a record \$1.5 billion in initial public offerings.

1998. The Information Technology Association of America estimates there are 346,000 open IT positions; in a contradictory survey, the American Engineering Association estimates that the number is closer to 96,000.

1998. The Automotive Network Exchange (ANX) is launched by the Automotive Industry Action Group, linking the Big Three American car companies with 10,000 suppliers.

2000. IDC estimates that information technology will indeed generate \$900 billion in 2000.

Blues Survivors

A survey reveals the CIO's rise from crisis to confidence. How do we keep it that way?

BY MICHAEL J. EARL

ABOUT A DECADE AGO, WHEN a collection of CIOs got together, it was misery time. They felt undervalued, overworked, under pressure and above all, frustrated. They felt they should be leading their organizations to new ways of doing business enabled by IT, but no one else would listen. After all, in the eyes of many of their business peers, they were techies who should be kept in their box, making sure the technology was working—

period. If it wasn't working, well, the popular thinking was, we should outsource as much as possible and maybe appoint a new CIO who knew his or her place and was a strong, hard-nosed manager. And if this replacement CIO wasn't always seeking corporate support for another IT standard, an infrastructure investment or a new strategic initiative, but would be quiet and invisible, even better! The more that CIOs of a decade ago shared their frustrations with each other, the more depressed they became. In fact,

I once heard a CIO remark that he would prefer to be a divisional CEO again and gladly take a 50 percent cut in salary

too. Even the media picked up on the occupational malaise, and in February 1990, *BusinessWeek* carried an article suggesting CIO means "Career Is Over."

No longer. A new CIO is here, according to a survey I have recently completed of almost 100 CIOs in the world's largest companies (sponsored by Egon Zehnder International), including the BBC, The Gillette Co., Smith Kline Beecham and Time

Warner Inc. This new CIO is unrecognizable in terms of role, status, expectations, capabilities and confidence when compared with the bleak picture of 10 years ago. For starters, more than 70 percent of respondent CIOs report that they are now on their company's main board or executive committee. They often take part in strategic meetings and generally are expected to make contributions on business as well as technology issues. Another significant trend the survey revealed is that 59 percent of CIOs report to the CEO or COO, with only 22 percent following the more traditional reporting line to the CFO. In other words, the role of CIO, far from being on the decline as some writers predicted a few years ago, is ascending. Indeed, in some senses, the role that CIOs have aspired to and demanded for years has finally materialized. Can they make the most of the opportunity? They'll need a deeper skill set covering a wider range of perspectives on their organization if they want to continue advancing the CIO's standing within their organizations.

Four Key Orientations

So what does the modern CIO do and where is he or she going next? My analysis of CIOs' activities suggests that the position remains first and foremost that of a technology policymaker, masterminding and overseeing technology choices, new technology adoption, corporate IT standards and information management policies and procedures. Furthermore the CIO is a functional leader, the senior executive presiding over what is still a large function in many corporations and in particular orchestrating continuous change in the skills and organization of IT departments.

Today's CIO also remains a systems strategist, ultimately responsible for planning the applications development portfolio and promot-



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Expert Advice

ing new initiatives to exploit technology in changing the way we do business. He or she also still has to focus on IT delivery, ensuring top-notch operational performance every day. As one survey respondent said, "If I don't deliver the mail, then I won't be able to effect change."

But two further roles are being demanded of, and fulfilled by, the modern CIO. He or she has become a change master, often leading projects and certainly being considered by the CEO as an executive whose responsibilities include change management. Some even have the term in their title, such as director of IT and process change, and as one of these CIOs put it, "I'm in the business of change." Another observed that wherever change programs were being implemented, IT was heavily involved. Second, at forward-thinking organizations, the CIO increasingly is a business strategist, participating in discussions and activities that determine where the business will go in the future and how it will compete. CIOs are leading experiments and new ventures in e-commerce, they are being asked to spot and buy relevant Internet startups, and some have formal business strategy responsibilities.

The CIO was always a technologist, responsible for infrastructure planning and technology policies. And in the last decade, where business has become ever more dependent on IT, the CIO survived only if she or he was fireproof on delivery and service. But now CIOs are expected to be able to both craft relevant IS strategies and contribute to business strategy-making. And increasingly they are charged with leading business change projects, not to mention transforming their own function. They need to bear in mind each of these responsibilities and how they interact.

CIOs are upbeat about their position and bullish about the corporate context they have to work in. Respondents report that board or executive committee support for IT has increased over the last five years, and they believe it will continue to grow. The same is true for involvement of the board or executive committee in IT matters. CIOs surveyed report that their corporations have willingly adopted corporatewide standards,

policies and application projects, and they sense that this trend will continue for some years.

The CIO Skill Set

To be equipped to cope with the demands outlined above, respondent CIOs believe three skill sets are vital: business know-how, technological confidence and behavioral skills—the last needing to be of an especially high order. For example, CIOs stress managing and facilitating change, personal communication skills, leadership, teamwork, and influencing peers and executive teams. In other words, the strategy and change orientations require much deeper and broader soft skills than ever before.

That array of required skills may not be surprising, but what is noteworthy is how respondents rated different types of career experience as a development path for an effective CIO. Clearly they all valued substantive experience in the IT function—to de-

Is the position becoming so demanding and challenging that no one person can cope, or will individual CIOs continue to respond to the rising expectations of their corporations? Opinions divided almost equally.

One favored scenario featured a single CIO responsible for technology policy-making, business and IS strategy-making, running a reliable infrastructure and daily operations and leading or facilitating change. The other favored scenario created two different positions. One is the CIO responsible for strategy matters, business change and managing information as a resource. This last domain is a recognition of the increasing importance of knowledge management and of the value of content in e-commerce. The second position is that of a CTO responsible for technology policy and IT operations (and perhaps technology forecasting).

The dual model is emerging in some corporations, often where the agendas are very wide or where no one ideal

Is the position becoming so demanding and challenging that no one person can cope, or will individual CIOs continue to respond to the rising expectations of their corporations?

velop both technological know-how and an understanding of how to manage a specialist function. Those who had held the position of CIO before deemed this even more valuable than did CIOs with other backgrounds. A striking finding, however, given the business strategist and change agent roles now demanded of the CIO, is that those who also had been a senior executive outside IT, or had run a business or business unit as CEO, rated such experiences the most useful of all. They said that running a business gave them perspective on what appropriate IT solutions look like and gave them judgment on when to push hard for change and when to relax.

The Future CIO?

The survey collected a host of other data, but the last question asked respondents their opinions on how the CIO's job would evolve over the next five years:

executive can be found who matches the new specification for the CIO. By contrast, the single model may avoid problems of ambiguity, conflicts and power-games. It is also the sort of position many industry watchers have called for for several years and the one to which would-be CIOs most likely aspire. It certainly is a big job and explains why salaries of top CIOs are commensurate in size to both the increased scope of the job and its consequent business risks. I find more and more top executives freely observing that the CIO has the most important job in the corporation, and some go on to say, "and they can be paid whatever they demand." Can there be a better market test of how far the role of CIO has come? 

Michael J. Earl is professor of information management at London Business School in England. He can be reached at mearl@lbs.ac.uk.

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Rebalancing Acts

To thrive in the next century, CIOs need to initiate changes necessary for improving IT quality. They can start by bringing customers and vendors together.

BY LEON A. KAPPELMAN

THE I.T. INDUSTRY IS OUT OF BALANCE. In the software industry especially, too much power has wound up in the hands of vendors at the expense of customers. Vendors have succeeded in weakening the power of customers by often making the cost of switching from one vendor's software to that of another prohibitive.

Quality, consistency and simplicity are largely lacking in today's software. Although change is sorely needed, software vendors will not do it voluntarily. For one thing, vendors believe—mistakenly—that it is not in their best interests to change. The types of changes we need are usually brought about by pain; vendors are not experiencing any pain to speak of right now, and might not as long as they can continue to pass on the cost of poor quality to customers. And to a great extent, customers aren't overly concerned with the imbalance inherent in the industry either. The economy is good and there's enough fat in the system to obfuscate the waste caused by the imbalance. Yet the status quo is not sustainable in the long run because of the large percentage of waste; software projects, for example, have a more than 25 percent total failure rate.

Consequently, it's up to CIOs—who should know better than anyone

the pain caused by poor quality—to instigate change in the industry. To do that, CIOs need to focus on relationships, not technical issues. That's

because vendors aren't the enemy. The problems and successes in the IT industry are the work of three groups: vendors, systems professionals and end-user customers. Each group needs to make some dramatic changes to restore balance to the industry.

Treating the Symptoms

Y2K is merely a symptom of the underlying quality and management problems in the IT world. Solving Y2K, at best, results in bringing IT shops up to where they always should have been; at worst, information assets just deteriorate further and operating costs rise. The so-called "high-tech workforce shortage" is largely, but not entirely, a symptom of problems with quality and management too.



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In other industries where quality lags, external competition and lemon laws can serve to bring about change. The auto industry, for example, sought improvements in quality and management practices only when its financial pain from higher-quality, lower-priced imports became too great. Lawsuits originating from unsafe and shoddy cars added to their motivation.

IT vendors and their lobbyists—powerful forces for the status quo in the high-tech industry—have done everything they possibly can to minimize their Y2K pain through legislative limits on their potential liabilities. Ethical, moral and legal questions of making others pay to clean up their mess aside—the sad thing is that this course of legislative action chosen by vendors will probably fail to achieve the desired effect of less overall financial responsibility.

But that's not the worst of it. To add insult to injury, by inviting legislative intervention into the industry, the vendor community has unduly laid the groundwork for a more complicated future. We will likely forever more have four groups to contend with, unless the original three—the vendors, customers and systems professionals—can figure out how to self-manage and rebalance the industry for the betterment of all. If these groups become further estranged from each other because of these laws, the legislative repercussions could include licensing and malpractice insurance for programmers, government-mandated standards for high-tech products and regulatory agencies that police IT operations. Impossible, you say? Ask the doctors, the auto manufacturers and the chemical companies if they thought government intrusion was impossible.

What's the solution? Is there any hope? Yes. Within the Society for Information Management, the infrastructure complexity reduction working group is establishing guidelines for how companies can reduce technical complexity and thus increase quality. The group—comprising systems professionals from AT&T Corp., Duke Energy Corp., International Paper and Northwestern Mutual Life, among others—hopes to engage vendors in discussions about

how they can reduce complexity together. Vendors need to act more responsibly like manufacturers in other industries and strive for higher quality and interoperability among their products.

Customers, but most importantly CEOs and other end-user executives, also need to act more responsibly. They need to start managing IT like any other asset by paying more attention to IT decisions, projects and practices. But the language and cultural gap between executive-level

If all executives want is the hot new thing or some expedient metric, that's what CIOs will give them.

customers and vendors is very large. The Y2K legislation and the threat of litigation by end-user companies won't help bring vendors and customers together. Neither will the further erosion of customers' rights in the pending Uniform Computer Information Transactions Act (UCITA), an initiative intended to create a uniform body of law governing software transactions. (For more details about UCITA, see www.2Bguide.com.)

Bringing the Parties Together

CIOs need to bridge the information gap between customers and vendors. They are the best hope for helping customers and vendors make the necessary changes in their behavior. But first the systems professionals need to change their own behavior.

In most cases, systems professionals make short-sighted decisions, regardless of the long-term life cycle costs to their employers. The result is that CIOs create a lot of work for themselves and their techie minions in a seemingly endless cycle of scrap and buy. If it's quality that CIOs are after, they'll have to get rid of their scrap-and-buy mentality.

If CIOs don't get rid of their short-sighted focus, someone could do it for them. The dynamics of the industry are in for a change. Y2K is like a big "we let you down, big time" notice from CIOs to their employers. As a result, more technology spending could fall under the purview of executives. Already, Howard Rubin, president of Rubin Systems Inc. in Pound Ridge, N.Y., and a Meta Group research fellow, estimates that

42 percent of technology budgets are controlled by business units and not IT departments. That percentage is greater than ever before and up from 22 percent in 1994.

If executives drive decision making, they could very well become more engaged customers. While many CIOs view this shift as a threat, it doesn't have to be that way. Users and vendors need to be more collaborative. CIOs have an opportunity to become the linchpin that holds together the relationship between vendors and executives.

In the end, this is a good thing. Maybe CIOs will finally figure out "IT alignment" as well as achieve the simplification and quality improvements needed in IT environments. While standards are part of the solution, much of the complexity inherent in software is a result of vendors not communicating with each other because they believe it's best to lock in customers to their products. CIOs can help change this by thinking long term rather than short term.

Of course, incentives for CIOs will need to reflect a long-term mind-set too. Rewards should be linked to the success of the enterprise, not the half-imaginary ROI of a specific project. If all executives want is the hot new thing or some expedient metric, that's what CIOs will give them. As CIOs, it's critical to see past the vendor marketing and partial measures and stress overall value to the enterprise.

The most effective way the IT industry has of minimizing the intervention of regulators, legislators and litigators is a willingness to change on the part of vendors and customers, and a proactive, customer-oriented high-tech workforce that brings vendors and customers together in meaningful dialogues aimed at the continuous improvement of information assets and the organizations that manage them. CIOs are the logical choice to lead this effort. Are they up to the challenge? **CEO**

Leon A. Kappelman is associate director of the Center for Quality and Productivity at the University of North Texas in Denton and co-chair of the Society for Information Management's Y2K Working Group.

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NEW PRODUCTS
AND STAYING AHEAD
OF THE CURVE

Edited by Cheryl Asselin

Everything Old Is New Again

Take another look at these technologies. Though they've been around awhile, they have an exciting future ahead.

BY HOWARD BALDWIN

TECHNOLOGY IS PUSHING OUT THE BOUNDARIES of the possible. Its potential is intoxicating—except if you're the CIO, who's responsible for managing this technological event horizon as its boundaries become indistinct. But that's technology: The more it advances, the more tenuous its connections, kind of like the ripple that fades after a pebble is dropped into a pond.

To illustrate this concept, CIO looked at the past, present and future of four technologies—handheld computing, customer relationship management, outsourcing and peripheral connectivity. Unlike the ripple, however, these technologies are not dissipating. They're gaining momentum, even though they're a long way from the pebble that initially propelled them.

Handheld Computing

About eight years ago, pen computing was all the rage. Every company out there, from NCR Corp. to Grid Systems Corp., marketed tablet-and-stylus computers for the gamut of users, including mobile professionals and factory floor personnel—anyone who found keyboards inconvenient. Other companies, such as Apple Computer Inc. and Casio Computer Co. Ltd., sold handheld computers or personal data assistants because they housed calendars and to-do lists and contacts. But they all failed, either because they were slow or complicated or because *Doonesbury* lampoons made them laughingstocks.

Into this handheld graveyard walked a ghostbuster named Jeff Hawkins, a Grid Systems alumnus who reconsidered what handheld computers should be and founded Palm Computing Inc. "Before Hawkins inte-



grated software and hardware together in the original Palm Pilot, systems were self-contained products that didn't connect to the desktop," says J. Gerry Purdy, president and CEO of Mobile Insights, a market researcher in Mountain View, Calif.

"People were misfocused on pen-based computing," adds Donna Dubinsky, who worked with Hawkins at Palm Computing and cofounded with him their new company, Handspring Inc., also based in Mountain View. "It was like saying 'keyboard-based computing' or 'mouse-based computing.' Jeff realized it wasn't about the pen—it was about making the device small enough that you could walk around with it."

People wanted devices that were small and ready to use, and would be complementary to PCs, not supplant them. As a result, the Palm computer had no printing capabilities. "When you put printer drivers in a small device, it slows it down," says Dubinsky, remembering that, at the time, the idea was so counterintuitive that she and

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Hawkins couldn't even find investors to fund the business.

Today, those are some very unhappy investors, since International Data Corp. (a sister company to CIO Communications Inc.) estimates that by the end of this year at least 5.5 million handhelds based on the Palm operating system will have shipped since 1996. In comparison, IDC estimates that in that same time frame some 3 million Microsoft Windows CE devices will have shipped since the operating system debuted in 1996. Like laptops and PCs before them, Palm computers have infiltrated the enterprise, and knowledgeable CIOs are taking advantage of their connectivity (see "Handhelds Reach Out," CIO, Sept. 15, 1998).

But we're still in the tin lizzie days of handhelds, maintains Purdy. "Wireless computing is tolerated more than it's embraced. When we get to the point that it's so easy to use that it disappears from our thinking process, then it will be pervasive." And we're slowly moving in that direction: The Palm V has a lithium-ion battery that automatically recharges in its cradle, whereas earlier versions use AA batteries that have to be replaced.

As for the future, Handspring is focusing on expandability, says Dubinsky. Although when she and Hawkins first founded the company—whose products use the PalmOS—they expected to create new consumer devices. But they soon realized that CIOs and vertical markets were crying out for Palm-like computers that incorporate GPS systems, expanded storage, bar code scanning and other capabilities, and they promptly changed their focus.

And will the new cellular telephones from Motorola Inc. and Nokia Corp. that allow Web access do to Palm computers what Palm did to pens? Purdy says no. "There are voice-centric and data-centric differences, and the form-factor differences of tall versus wide." Eventually, he says, the two will rely on technology from the Bluetooth consortium (www.bluetooth.com), which is working on connectivity between wireless devices. "You won't have to put all the features of a phone in a computer or vice versa; you'll just communicate between the two."

You Can Touch This

Using software developed at MIT and hardware created by Suzuki, virtual reality becomes even more real

TODAY'S VIRTUAL REALITY (VR) systems can stimulate the senses of vision, hearing and motion but still leave users feeling untouched.

This may soon change. Researchers at MIT's Rapid Autonomous Machining Laboratory in Cambridge, Mass., have developed software that allows VR users to

dimensional bodies—a user's hand and a teacup, or a foot and a football, for example. "Approximating a haptic interface as a point is computationally easier, but the full geometry of the tool is ignored and much of the realism is lost with it," says Sarma. "Our methodology enables full three-dimensional modeling in haptic environments."

Not surprisingly, haptic systems require plenty of processing power. MIT's software was designed to make the best use of the fastest processors available. "Computer graphics have become more sophisticated thanks to advancements

touch virtual objects with full three-dimensional realism. The advance has the potential to bring VR one step closer to fully representing all the intricate aspects of the physical world.

The MIT software, when combined with "haptic" hardware developed by engineers at Japan's Suzuki Motor Corp., creates a system that could someday let doctors touch replicas of body tissue or allow engineers to feel spatial relationships among parts in a virtual vehicle assembly. Some computer games already include simple "force feedback" haptic systems that simulate physical touch through special joysticks, steering wheels, yokes and other control devices. The MIT-Suzuki project aims to take the technology to the next level.

Sanjay Sarma, an associate professor at MIT and leader of the 3-D haptics project, explains that current haptic interfaces limit VR touch presence to just a single point, allowing users to experience little more than a VR poke. The new technology extends the capabilities of haptic interfaces by simulating the interaction between three-

in rendering techniques and computer processing power," says Sarma. "In a similar way, haptic development will benefit from greater processing power as well as advancements in software technology."

The first real-world application of the new technology is a hand-and-arm-operated haptic system—with motors and gears—that lets users create machining tool paths for rapid prototyping. The user manipulates a cutting tool in virtual space to teach the machine how to cut a specified object.

Sarma expects even more sophisticated haptic systems to become widely available over the next several years to handle a range of industrial, medical and entertainment applications. "As we crack the speed barriers in haptic rendering, I expect more applications to crop up, more sales to emerge and lower prices as a result."

—John Edwards



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Customer Relationship Management

Technology has taken CRM far beyond just tracking frequent flyer miles. Companies can not only compile information on what customers buy from the Web, but CRM software lets them interact with customers (through e-mail or the Web), determine who's buying what and figure out how to create loyalty in customers' hearts. The key word here is *ideally*, since on the Web your customer is just a click away from your competitor.

Those who sleep and eat customer relationship management disagree on whether its heritage lies in databases, contact management systems or both. "It's contact management on steroids," insists Gayle Crowell, president of the E-Commerce Division of E-piphany Inc.

On the other hand, Martha Rogers, partner at the Peppers and Rogers Group in Stamford, Conn., and coauthor of *The One to One Future: Building Re-*

so that you are more likely to ship packages when it's easier for FedEx to handle the load. Moreover, because you're now invested in the relationship, you're probably not going to bring in a competitor to set up a similar system.

Crowell and Rogers also don't necessarily agree on the future of CRM.

Rogers thinks companies will reserve one-to-one marketing for their best and most profitable customers. "The Web-based grocery delivery company does not want all customers the way its brick-and-mortar counterparts do," she says. "It

wants the 12 percent of busy suburban families with two jobs, pets or a pool," noting that these are the people who replenish their sundries and groceries regularly, the kind who don't count pennies but do eat prepared foods—those with the biggest profit margins.

Crowell, however, believes CRM will go mainstream. "Customer expectations are going higher and higher at the same time markets are becoming more com-

misuse it, and you're going to use it to save the customer time, the customer isn't freaked out by it, and she doesn't have to fill out a form. It shows you're a company that respects privacy."

Outsourcing

It all began with time sharing. You didn't buy a computer; you bought *time* on a computer, logging in and running whatever applications you needed. When computers were expensive, it was an inexpensive way to access computing cycles. Soon computers became less expensive, but some CIOs believed computing wasn't their core competency. That led to outsourcing, which took off just a decade ago (see "10 Years That Shook IT," *CIO*, Oct. 1, 1999).

"With outsourcing, you're talking about OPR—other people's resources—which have become more valuable than other people's money," says Frank Casale, president of The Outsourcing Institute in Jericho, N.Y. "It's easier for most companies to get cash than [it is to get] resources."

But even outsourcing is morphing. Its future is the nascent application service provider (ASP) category—in which companies pay on a subscription basis for someone else to run their applications and store their data, which they can access over the Internet. "Now you have startup companies—e-businesses that have no back office, don't want one and will never have one," says Casale. "These companies are establishing relationships with service providers to build and own their infrastructures from the very beginning." In essence, he says, their first employee is really somebody else's employee who's in shipping or logistics or IT. This leaves the e-business—or any business—free to focus on the front end, the customers.

Casale says the ASP trend has been dubbed "back to the future" because it so closely resembles time sharing. But it has a brighter future than time sharing. "Companies are realizing that process is king. The IT infrastructure, the software, the database, the ERP technology—they're the underpinning, the drivers. But it's not how people will make decisions. The technology becomes virtual



"CRM is contact management on steroids."

—Gayle Crowell, president, E-Commerce Division of E-piphany

lationships One Customer at a Time, believes that CRM descended from mass-marketing databases. Rogers cites four steps to CRM: identifying people, differentiating them, asking them questions and treating them differently based on their answers. "The first three [steps] are database marketing. It's when you take that fourth step, using the information to do something for that customer that [he or she] can't get without starting all over, then you've gotten the customer to add the value to the relationship."

Federal Express Corp.'s PowerShip system is a perfect example of snagging the customer, says Rogers. The shipping service lets customers label their packages and track their progress from their own desktops. "It's gotten you to do all the work, and you're thrilled about the whole thing." Also, FedEx now knows exactly how much you ship and when you ship it, and it could conceivably adjust its rates

petitive," she says. "The mainstream customers want service that's personalized and customized. Technology is one of the ways you can do that." But she takes the idea one step further, suggesting that eventually customers will be able to drive the creation of products they want through CRM interactivity. "When companies can do a better job communicating with the customer, they'll be able to create better products and expand their business. It will be a competitive advantage to do so," Crowell says.

Crowell also envisions Web site visitors eventually choosing digital shopping companions, similar to avatars, to help them through a Web site. And they'll have a choice of avatars to match their personalities: career woman with kids, bachelor with pets and so on. "That becomes the personalization tool you give the customer," notes Crowell. "If it's nonintrusive and you're not going to

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"ASPs are doing for applications what the Internet did for data," says Traver Gruen-Kennedy, chairman of the ASP Industry Consortium (a group of 200 companies led by Citrix Systems Inc., and includes AT&T and Sun Microsystems Inc.). "They're providing affordable and universal access and ubiquity." The other trend driving ASPs is the advancement in the voice and data network. "As we move from desktop to net-top, people are going to be able to use the network the same way the backbone works in a PC," adds Gruen-Kennedy. "All the complexity of the networking is removed from the end user. The network is instant-on, affordable, and I can use it like water."

The trend toward ASPs is especially prevalent at the new dot-coms, says John Puckett, CIO of Toysmart.com in Waltham, Mass. Small companies want to be on the Internet without worrying about business processes, but they aren't interested in building the technology to get there. There's a paradox, though, Puckett notes. If you're a small company, you can't afford an ERP application, though you may want to use an ASP to get a piece of one, the same way you might lease a piece of a T1 line for telecommunications. "But ERP takes an awful lot of thinking about an individual company's processes, whereas economies of scale are geared toward a standard implementation."

In the future, expect more highly interwoven outsourcing partnerships. "It used to be that you got low pricing [on an outsourcing contract], and a year later you're nickel-and-dimed to death in the upgrades," says Casale. He foresees situations where the ASP will have its "skin in the game," in which if the company's profit soars, the ASP is compensated appropriately (beyond what it would get for average returns). Casale thinks ASPs have a right to ask, "How come if we miss a deadline there's a penalty, but if profits double, we don't get another dime?"

Peripheral Connectivity

Joe Beyers has been with Hewlett-Packard Co. since the Nixon administration, so when you talk to him about peripheral connectivity, he can recall some horrific stories. Back then every proprietary computer had its own plug-compatible peripherals, but the challenge and expense didn't stop there. "There were challenges even with the subelements of a single processing system," he notes. "In the HP 3000 minicomputer, if you wanted one element to talk to another,

HP's and Sun's projects are aimed at enabling peripherals to automatically connect without device drivers.

you had to write custom code and do major integration. Now we have object technology and communications protocols, so all that complexity is hidden."

Recognizing that, Microsoft Corp. has attempted to endow Windows with plug and play capabilities, but it hasn't been entirely successful: The company first announced it for Windows 95, but that operating system was no better than earlier plug and "pray" systems. Then it announced those capabilities for Windows 98, and the jury is still out on that.

In the meantime, Hewlett-Packard and Sun Microsystems are tackling the problem of peripheral connectivity on their own. Beyers, general manager of HP's Internet business unit, is in charge of the Chai (like *high* with a soft *ch*) Appliance project at HP, and Jim Waldo—now a distinguished engineer—was the chief architect of the Jini project at Sun. Both projects are aimed at enabling peripherals to automatically connect without device drivers.

"The intelligence should be in the device being talked to, not the device doing the talking," says Waldo. "The PC doesn't need the intelligence to talk to everything it might need to talk to." Besides, the more innovations you have, the smarter the PC needs to be in order to talk to peripherals. For CIOs, it's easier if you don't have to update everything in your network when you update a new device.

Naturally, Beyers and Waldo disagree

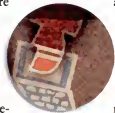
about the utility of each of their technologies. Beyers notes that Chai is based on standard Internet protocols, whereas Jini is proprietary to Sun. Waldo argues that Jini is an evolution beyond Chai because as it becomes widely adopted in the next two years, it will encompass not just peripherals but services like e-mail and spellchecking.

David Usechak, program manager and chief software engineer for the Program Executive Office (PEO) of Command, Control and Communi-

cations Systems (C3S) for the U.S. Army at Fort Monmouth, N.J., looked at both technologies because such intelligent connectivity would be a boon in the field. "Mobility is a key factor for us. Continuously and in a random fashion, workstations will shut down, go away, come back and plug into a network." That brings complexity the Army doesn't need in battle conditions. For example, the Sun workstations the Army currently has carry about 50 printer drivers. "Wouldn't it be nice not to carry any of those?" asks Usechak. "If somebody had a new printer, and the Army decided to buy it, all I'd have to do is deliver it to the field and not worry about whether the drivers were there and [whether they] worked with that workstation." The last thing Usechak wants to do is deploy technical support people in the middle of a battle.

The Army is currently testing Jini, with plans to deploy its first "digital division" around September 2000. The decision to go with Jini was based on the fact that it came out first and that it works with the Army's existing workstations. With the stoicism of a long-suffering technophile, Usechak says, "[Jini and Chai] don't work together. It's going to take a little time for these technologies to sort themselves out." But eventually, he says, they are going to have to interoperate. **CIO**

Howard Baldwin is a former senior editor at CIO.



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LIKE FATHER, LIKE SON

Two IS managers—father and son—talk about their careers, technology and how IT has changed **BY TOM WAILGUM**



BOB POULIOT, 53

Former Senior Vice President of Information Systems, MassMutual Financial Group, a financial services company in Springfield, Mass.; now retired.

MIKE POULIOT, 28

MIS Project Manager, Norton Co. (a subsidiary of Saint-Gobain Corp. in Paris), a manufacturer of coated and bonded abrasive products in Worcester, Mass.

I.T. CAREER PATH

Bob: Two companies in 30 years; The Travelers Insurance Co. (1969-1972); MassMutual (1972-1999).

Mike: Two companies in 7 years; Andersen Consulting (1993-1997); Norton (1997-present).

FIRST COMPUTER USED

Bob: RCA 501 System.
Mike: Commodore 64.

I.T. TRAINING

Bob: None. "I had absolutely no training until [I went to] Travelers. I was an accounting major at Western New England College."

Mike: Yes. Started programming in Basic on Commodore 64; in high school, took Basic and Pascal classes; at Boston College, majored in information systems.

FIRST I.T. JOB/SALARY

Bob: Programmer trainee, coding Cobol programs; \$7,500.
Mike: Staff consultant, working on ERP systems; \$30,000+.

WHY I.T.

Bob: "When I got my accounting degree, the one thing I knew after four years in accounting was that I didn't want to be an accountant."

Data processing was a new field and companies were willing to train you."

Mike: "I wanted to get into business, and at that point business and computers were a nice combination."

CAREER ASPIRATIONS

Bob: "I never had aspirations to reach the level I have reached. Back in the first 10 to 15 years, people felt they were data processors—it didn't matter what business they were working in. The business was secondary. That has changed."

Mike: "I could see myself managing a business or managing an IT department. I don't want to be in a situation where all I know is the technology. I want to know the business and the business requirements."

WORKWEEK

Bob: 45 hours a week. "We're always on call, beepers, voice mail."

Mike: 45-55 hours a week. "I'm also getting my MBA part time."

TECHNOLOGIES THAT SURPRISED THEM

Bob: The Internet. "Even three years ago, we would not have been able to guess how big it would be."

Mike: The Internet. "When it first came around, I thought it was pretty neat. But it didn't even cross my mind that you could link four different companies through the supply chain, everybody could look at everybody else's inventory, and now there's a totally different way of doing business because of the Internet."

TECHNOLOGIES THAT DISAPPOINTED THEM

Bob: The paperless office, artificial intelligence, voice recognition.

Mike: Client/server.

GREATEST TECHNOLOGY

Bob: The PC.
Mike: The PC.

OUTSIDE THE OFFICE

Bob: Golf, guitar ("Mike's the better player"), books, travel.

Mike: Golf, guitar, MBA course work, chess.

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